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PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

VOL. I.

DUBLIN:
PRINTED BY R. GRAISBERRY,
PRINTER TO THE ACADEMY.
MDCCCXLI.

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* The third of the tables of the elastic force of vapour, referred to in this communication, pp. 443, 444, has been erroneously attributed to Mr. Lubbock.

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY,

FOR THE YEAR 1836-7.

PART I.

DUBLIN:

PRINTED BY R. GRAISBERRY.

PRINTER TO THE ACADEMY.

M.DCCC.XXXVII.

GEOLOGICAL
DUBLIN
SOCIETY.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1836—1837. No. 1.

October 24, 1836.

Rev. B. LLOYD, D. D., Provost, T. C. D., President, in the Chair.

Rev. Edward Marks, Frederick Darley, Esq., Rev. John A. Bolster, and Rev. James S. Reid, D. D., were elected Members of the Academy.

A paper was read, entitled "Contributions to the History of Pyroxylic Spirit, and the derived Combinations." By Robert J. Kane, M. D. M. R. I. A., Professor of Natural Philosophy in the Royal Dublin Society.

In this paper Professor Kane stated that he had repeated the analysis of pyroxylic spirit and of methylic ether, and found the composition given by Dumas for these bodies to be perfectly correct. He likewise re-examined the pyroxylic spirit, described and analysed by Liebig, having been presented with a specimen of the original spirit for that purpose by Professor Liebig. The result of his experiments is, that the pyroxylic spirit of Liebig is quite distinct from that of Dumas; and that both of these chemists were right in the analyses which they published.

By treating the pyroxylic spirit of Dumas (methylic alcohol) with peroxide of manganese and sulphuric acid, there is obtained a light colourless liquor boiling at 103° Fahrenheit.

It is composed of $C_4 H_{10} O_3$. It may be considered as tritoxide of ethyl AE. O. or as corresponding in the methylene series to the acetal in the alcoholic, being a tribasic formomethylic ether; thus,

$$3 \times C_2 H_6 O = C_6 H_{18} O_3 \text{ three atoms methylic ether.}$$
$$C_2 H_2 O_3 \text{ one atom formic acid.}$$
$$\overline{C_8 H_{20} O_6 \div 2 = C_4 H_{10} O_3.}$$

the density of its vapour is 2,45.

The pyroxylic spirit of Liebig, $C_4 H_{10} O_2$, is considered by Professor Kane to be not a deutoxide of ethyl, but a tribasic ether, containing the methylene aldehyd. Thus,

$$3 \times C_2 H_6 O = C_6 H_{18} O_3 \text{ three atoms methylic ether.}$$
$$C_2 H_2 O \text{ methylic aldehydene.}$$
$$\overline{C_8 H_{20} O_4 \div 2 = C_4 H_{10} O_2.}$$

The analysis of the heavy oily liquor obtained by the action of chlorine on methylic alcohol, as pointed out by Dumas, is given by Professor Kane as leading to the formula $C_6 Cl_3 H_4 O_2$. The products of its decomposition by bases will form part of a subsequent paper.

An oil which accompanies pyroxylic spirit gave for its composition $C_{20} H_{30} O$. isomeric with the resinain of Fremy.

Professor Kane has found pyroxylic spirit to form a compound with chloride of calcium crystallizing in plates, (hexagonal,) consisting of one atom of chloride of calcium with two of the pyroxylic spirit.

A paper was also read, "On the laws of Reflexion from Metals." By James Mac Cullagh, M. R. I. A., Professor of Mathematics in the University of Dublin.

The author observes that the theory of the action of metals upon light is among the *desiderata* of physical optics, whatever information we possess upon this subject being

derived from the experiments of Sir David Brewster. But, in the absence of a real theory, it is important that we should be able to represent the phenomena by means of empirical formulæ; and, accordingly, the author has endeavoured to obtain such formulæ by a method analogous to that which Fresnel employed in the case of total reflexion at the surface of a rarer medium, and which, as is well known, depends on a peculiar interpretation of the sign $\sqrt{-1}$. For the case of metallic reflexion, the author assumes that the velocity of propagation in the metal, or the reciprocal of the refractive index, is of the form

$$m(\cos\chi + \sqrt{-1}\sin\chi);$$

without attaching to this form any physical signification, but using it rather as a means of introducing two constants (for there must be two constants, m and χ, for each metal) into Fresnel's formulæ for ordinary reflexion, which contain only one constant, namely, the refractive index.

Then if i be the angle of incidence on the metal, and i' the angle of refraction, we have

$$\sin i' = m(\cos\chi + \sqrt{-1}\sin\chi)\sin i, \qquad (1)$$

and therefore we may put

$$\cos i' = m'(\cos\chi' - \sqrt{-1}\sin\chi')\cos i, \qquad (2)$$

if

$$m'^4\cos^4 i = 1 - 2m^2\cos 2\chi\sin^2 i + m^4\sin^4 i, \qquad (3)$$

and

$$\tan 2\chi' = \frac{m^2\sin 2\chi\sin^2 i}{1 - m^2\cos 2\chi\sin^2 i}. \qquad (4)$$

Now, first, if the incident light be polarized in the plane of reflexion, and if the preceding values of $\sin i'$, $\cos i'$, be substituted in Fresnel's expression

$$\frac{\sin(i-i')}{\sin(i+i')},$$

for the amplitude of the reflected vibration, the result may be reduced to the form

$$a(\cos\delta - \sqrt{-1}\sin\delta), \qquad (5)$$

if we put

$$\tan\psi = \frac{m}{m'}, \tag{6}$$

$$\tan\delta = \tan 2\psi \sin(\chi + \chi') \tag{7}$$

$$a^2 = \frac{1 - \sin 2\psi \cos(\chi + \chi')}{1 + \sin 2\psi \cos(\chi + \chi')}. \tag{8}$$

Then according to the interpretation, before alluded to, of $\sqrt{-1}$, the angle δ will denote the *change of phase*, or the retardation of the reflected light; and a will be the amplitude of the reflected vibration, that of the incident vibration being unity. The values of m', χ', for any angle of incidence, are found by formulæ (3), (4), the quantities m, χ, being given for each metal. The angle χ' is very small, and may in general be neglected.

Secondly, when the incident light is polarized perpendicularly to the plane of reflexion, the expression

$$\frac{\tan(i - i')}{\tan(i + i')}$$

treated in the same manner, will become

$$a'(\cos\delta' - \sqrt{-1}\sin\delta'), \tag{9}$$

if we make

$$\tan\psi' = mm', \tag{10}$$

$$\tan\delta' = \tan 2\psi' \sin(\chi - \chi'), \tag{11}$$

$$a'^2 = \frac{1 - \sin 2\psi' \cos(\chi - \chi')}{1 + \sin 2\psi' \cos(\chi - \chi')}; \tag{12}$$

and here, as before, δ' will be the retardation of the reflected light, and a' the amplitude of its vibration.

The number $\text{M} = \frac{1}{m}$ may be called the *modulus*, and the angle χ the *characteristic* of the metal. The modulus is something less than the tangent of the angle which Sir David Brewster has called the maximum polarizing angle. After two reflexions at this angle a ray originally polarized in a

plane inclined 45° to that of reflexion will again be plane polarized in a plane inclined at a certain angle ϕ (which is 17° for steel) to the plane of reflexion; and we must have

$$\tan\phi=\frac{a'^2}{a^2}. \tag{13}$$

Also, at the maximum polarizing angle we must have

$$\delta'-\delta=90°. \tag{14}$$

And these two conditions will enable us to determine the constants M and χ for any metal, when we know its maximum polarizing angle and the value of ϕ; both of which have been found for a great number of metals by Sir David Brewster. The following table is computed for steel, taking M $=3\frac{1}{2}$, $\chi=54°$.

i	δ	δ'	a^2	a'^2	$\frac{1}{2}(a^2+a'^2)$
0°	27°	27°	.526	.526	.526
30	23	31	.575	.475	.525
45	19	38	.638	.407	.522
60	13	54	.729	.308	.5 8
75	7	98°	.850	.240	.545
85	2	152	.947	.491	.719
90	0	180	1.	1.	1.

The most remarkable thing in this table is the last column, which gives the intensity of the light reflected when common light is incident. The intensity *decreases* very slowly up to a large angle of incidence, (less than 75°,) and then increases up to 90°, where there is total reflexion. This singular fact, that the intensity decreases with the obliquity of incidence, was discovered by Mr. Potter, whose experiments extend as far as an incidence of 70°. Whether the subsequent increase which appears from the table indicates a real phenomenon, or arises from an error in the empirical formulæ, cannot be determined without more experiments. It should be observed, however, that in these very oblique incidences Fresnel's formulæ for transparent media do not represent the actual phenomena for such media, a great quantity

of the light being stopped, when the formulæ give a reflexion very nearly total.

The value of $\delta'-\delta$, or the difference of phase, increases from 0° to 180°. When a plane-polarized ray is twice reflected from a metal, it will still be plane-polarized if the sum of the values of $\delta'-\delta$ for the two angles of incidence be equal to 180°.

It appears from the formulæ that when the characteristic χ is very small, the value of δ' will continue very small up to the neighbourhood of the polarizing angle. It will pass through 90°, when $mm'=1$; after which the change will be very rapid, and the value of δ' will soon rise to nearly 180°. This is exactly the phenomenon which Mr. Airy observed in the diamond.

Another set of phenomena to which the author has applied his formulæ are those of the coloured rings formed between a glass lens and a metallic reflector; and he has thus been enabled to account for the singular appearances described by M. Arago in the *Memoires d'Arcueil,* tom. 3, particularly the succession of changes which are observed when common light is incident, the intrusion of a new ring, &c. But there is one curious appearance which he does not find described by any former author. It is this. Through the last twenty or thirty degrees of incidence the first dark ring, surrounding the central spot which is comparatively bright, remains constantly of the same magnitude; although the other rings, like Newton's rings formed between two glass lenses, dilate greatly with the obliquity of incidence. This appearance was observed at the same time by Professor Lloyd. The explanation is easy. It depends simply on this circumstance, (which is evident from the table,) that the angle $180°-\delta'$, at these oblique incidences, is nearly proportional to $\cos i$.

As to the index of refraction in metals, the author conjectures that it is equal to $\dfrac{\text{M}}{\cos\chi}$.

Rev. Robert Gage exhibited specimens of Coal and Iron stone, recently found in Rathlin Island, on the North coast of Ireland.

DONATIONS.

Archæologia; or Miscellaneous Tracts relating to Antiquity, vol. xxvi. Presented by the President and Council of the Society of Antiquarians of London.

Copy of the Ordnance Survey of the County of Louth, in 27 sheets, presented by Lieut. Colonel Colby, R. E.

Philosophical Transactions of the Royal Society of London, for the years 1834, Part 2; 1835, Parts 1 and 2; and 1836, Part 1. Presented by the Society.

List of the Fellows of the Royal Society. By the same.

Memoir of the Fresh-water Limestone of Burdiehouse, in the neighbourhood of Edinburgh. By Samuel Hibbert, M. D., F.R. S. E. Also, *Analysis of Coprolites, and other Organic Remains, imbedded in the Limestone of Burdiehouse*. By Arthur Connell, Esq., F. R. S. E. Presented by Doctor Hibbert.

History of the Extinct Volcanos of the Basin of Neuweid, on the lower Rhine. By Samuel Hibbert, M. D., F. R. S. E. Presented by the Author.

Memoir on the Theory of Partial Functions. By John Walsh. Presented by the Author.

An Essay on the Origin and Nature of Tuberculous and Cancerous Diseases. By Richard Carmichael, M.D., M.R.I.A. Presented by the Author.

Transactions of the American Philosophical Society. Vol. v. Part 2. (New Series.) Presented by the Society.

Transactions of the Geological Society of London. Vol. iii. Part 3. (Second Series.) Presented by the Society.

November 30. (Stated Meeting.)

Rev. B. LLOYD, D. D., Provost, T. C. D., President, in the Chair.

William E. Bolton, Esq. and Thomas F. Bergin, Esq. were elected Members of the Academy.

Sir William Betham exhibited to the Academy a specimen of the ancient brazen ring money, found in the county of Monaghan,* and also a piece of cast iron, found with many others, in boxes, on board a vessel wrecked on the coast of Cork last summer. This vessel was bound to Africa, where it is stated the pieces in question pass for money. They are so similar in shape and size to the ancient specimens, that there can be no reasonable doubt of the identity of their uses; and thus the theory advanced in the paper referred to is strongly confirmed.

Sir William Betham also read an extract of a letter from a friend, in which it was stated, that gold rings, exactly formed like those found in the Irish bogs,—that is, of gold wire turned into the form of rings, but not united at the ends,—pass current at this moment as money in Nubia and Sennaar.

The Dean of St. Patrick's exhibited two bronze specimens of the first mentioned articles found in Italy, one of which was encrusted with crystals of carbonate of lime.

The following papers were read:

1. "On the Affinity of the Hiberno-Celtic and Phœnician Languages." By Sir William Betham, M. R. I. A., Secretary of Foreign Correspondence.

In this paper the author undertakes to prove that the names of the divinities, heroes, and nymphs of the Greeks and Romans, are significant in the Hiberno-Celtic language;

* See paper read 23rd May and 27th June, page 12.

that many of the ancient names of countries, seas, and places are also significant; and that the same thing is true of the names of the Etruscans and Pelasgi, as well as of the words of both these people which have come down to us in the Greek and Roman writers. From this he infers that the Pelasgi, the Etruscans, and the Celts were all colonies of the Phœnician people, and all spoke the language now called Gaelic or Hiberno-Celtic. He instanced the remarkable fact mentioned by Suetonius in his Life of Augustus Cæsar, (c. 97,) where, giving an account of the death of Augustus, and the omens which preceded it, he says:

"Sub idem tempus ictu fulminis ex inscriptione statuæ ejus prima nominis litera effluxit. Responsum est centum solos dies posthac victurum, quem numerum C litera notaret; futurumque ut inter deos referretur, quod ÆSAR, id est reliqua pars e Cæsaris nomine, Etrusca lingua *Deus* vocaretur."

Aosar is one of the Irish names for God, and not only is the word itself to be found in the Irish dictionaries and MSS. but it is compounded of two Irish words meaning *the eternal ruler*, or *ruler of ages*: aos, *ages*—ar, *ruler*.

The author gave many examples of the significance of the names of the Greek and Roman divinities, and also of the ancient names of countries, in the Hiberno-Celtic language; among them the following:

Aurora—the golden hour, or sunrise.

Bacchus—the lame drunkard.

Diana—the goddess.

Gorgones—the frightful women.

Haruspex—judging from a pang or throe.

Iris—the sun and the shower.

Neptune—the king of the waves.

The names of the Nereides denote the flitting aerial nymphs; the nymph of the sea weed; the silent nymph; the spark of the wave; the nymph of the deep water, the

rock, the estuary, the storm, &c. &c. The word nymph also means the holy one, or one set apart.

Pluto—the miner, or one who lives in a cave.

Sesostris—the name applied to Rameses the Great by the Greeks,—implies the fortunate, scientific, and powerful prince.

Silenus—the staggering drunkard.

Venus—the woman of the community; the courtesan.

Of the names of countries:—

Abyssinia—the country of rain.

Ethiopia—the country of springs or wells.

Assyria—the old country of power.

Egypt—the cultivated valley.

The Euxine—the little sea.

The Adriatic—the sea of enchantment, &c. &c. &c.

The author affirmed that examples of this kind were so numerous and so striking, that it was impossible to ascribe them to accidental coincidence; and he inferred from all, that these names were given by the Phœnicians, and that the Hiberno-Celtic was the language spoken by that people.

2. "On the Propagation of Light in Uncrystallized Media." By the Rev. H. Lloyd, F. R. S., M. R. I. A., Professor of Natural Philosophy in the University of Dublin.

The objects of the author have been—1. to simplify and to develop that part of M. Cauchy's theory, which relates to the propagation of light in an ethereal medium of uniform density; 2. to extend the same theory to the case of the ether enclosed in uncrystallized substances, taking into account the action of the material molecules.

Some of the simplifications adopted in the first part of these inquiries suggest themselves naturally. Thus the *axes of symmetry* of the medium are taken as the axes of coordinates, and the direction of propagation is assumed to coincide with one of these axes. By these suppositions the

differential equations of motion are reduced to a very simple form; and it is manifest that the assumptions themselves involve no real limitation of the problem. The well known expressions for the component displacements are deduced by the integration of these equations. The following is that in the direction of the axis of x:

$$\xi = a \cos (ut - kx + a);$$

in which

$$u = \frac{2\pi}{\tau}, \quad k = \frac{2\pi}{\lambda},$$

τ being the period of vibration, and λ the length of the wave. These quantities are connected by a relation given by the method of integration.

The preceding formula, however, is not the most general form of the expression for the displacement. It is found that in certain cases the integral becomes

$$\xi = a e^{-hx} \cos (ut - gx + a).$$

From this expression it follows that the amplitude of the displacement, and therefore the intensity of the light, decreases in geometrical progression, as the distance increases in arithmetical progression; and as the constant h is in general a function of u, or of the colour, the differently coloured rays will be *differently absorbed.* The complete value of ξ being the sum of a series of terms similar to the preceding, it is manifest that we have here a satisfactory account of the apparently irregular distribution of light in the absorbed spectrum. To explain the absolute deficiency of the light at certain points, it is only necessary to admit that the function h varies in certain cases *rapidly* with moderate changes in u, and becomes *very great* for certain definite values of that quantity.

The preceding integral has been already obtained by M. Cauchy, in a valuable memoir recently printed in lithograph. The method employed by the author seems, how-

ever, to be fundamentally different from that of M. Cauchy; and in fact he was led to this form of the integral by other considerations before he was aware that he had been preceded in the deduction.

The remainder of the present communication is taken up with the discussion of the relation between the coefficients u and k, which expresses the law of dispersion. Following M. Cauchy,* the author has transformed this relation by converting the triple sums into triple integrals; and he has found that, by applying this transformation at an earlier stage of the investigation, the resulting relation is deduced with great simplicity.

The relation between u and k, for the vibrations in the plane of the wave, has already yielded to M. Cauchy the probable result, that the molecules of the ether repel one another according to the inverse fourth power of the distance. When this law of force is substituted in the corresponding relation for the *normal* vibration, the author finds that the resulting value of $\frac{u}{k}$, or of the velocity of propagation, is infinite; so that the normal disturbance is propagated *instantaneously*, and gives rise to no wave. Thus the hypothesis of transversal vibrations seems to be established on theoretical grounds.

The author finally gives reasons for concluding that the theory, in its present form, is insufficient to explain the phenomena of light in bodies; and that it becomes necessary in this case to take into account the action of the material molecules. This extension of the theory will be given in a future communication.

3. "On the Composition of Thebaine." By Robert J. Kane, M. D., M. R. I. A., Professor of Natural Philosophy in the Royal Dublin Society.

* Nouveaux Exercices de Mathematiques. Livraison 7^{me}.

The author gave an account of the analysis of the vegetable alcaloid thebaine (paramorphine) which had been discovered in opium, and of which the analysis by Pelletier and Couerbe gave discordant results. With a specimen which had been prepared by Apothecary Merck of Darmstadt, Dr. Kane obtained the formula $C_{25}\,N_2\,H_{28}\,O_3$, (Berzelian atoms,) and giving the per cent. composition:

25 Carbon	= 74,57	=	1910,925
2 Azote	= 6,89	–	177,036
28 Hydrogen	= 6,83	–	174,714
3 Oxygen	= 11,71	–	300,000
	100,00		2562,675

Owing to the circumstance of the salts of this base with the mineral acids being uncrystallizable, the atomic weight obtained by analysis could not be synthetically confirmed.

Professor Kane read likewise an extract of a letter from Professor Liebig, of Giessen, communicating some new results of chemical analysis.

It was resolved, on the recommendation of council, that the bye-laws relating to the meetings of the Academy and Council (Chap. IV. Sects. 2 and 6), be altered, and the following substituted :—

(2.) "That a General Meeting of the Academy shall likewise be held on the *second* Monday of November and December, and on the *second* and *fourth* Mondays of January, February, April, May, and June, at 8, P. M. At these Meetings, such communications as shall have been approved of by the Committees during the preceding part of the month, shall be read."

(6.) "That the Stated Meetings of the Council shall be held on the *first* and *third* Monday of every month, from November to June, inclusive; with power to adjourn, from time to time, at all times of the year. Five to be a quorum."

It was further resolved, on the recommendation of Council, that the "Proceedings of the Royal Irish Academy," be printed every month during its sittings, for the use of its members.

"The Proceedings" to be under the management of the Council, and to contain—

1. Abstracts of the larger papers read to the Academy.
2. Minor communications, not intended for the Transactions, printed more at length.
3. Notices of the election of Members, of presents received, and of all other matters of general interest transacted at the Meetings of the Academy.

DONATIONS.

A copy of the Ordnance Survey of the County of Donegal, in 112 sheets. Presented by Lieut. Colonel Colby.

Flora Batava, No. 107. By H. C. Van Hall. Presented by the Author.

Estatutos da Academia Real das Sciencias de Lisboa. Presented by the Society.

Der erste Unterricht des Taubstummen. Von M. C. G. Reich. Presented by Henry Holmes Joy, Esq.

Bliche auf die Taubstummenbildung. Von M. C. G. Reich. Presented by the same.

Astronomical Observations made at the Observatory of Cambridge, for the year 1835. By George Biddell Airy, Esq., Astronomer Royal. Presented by the Author.

Six lectures on the Wave-theory of Light. By the Rev. H. Lloyd, F. R. S., &c. Presented by the Author.

Reports of the Committee of the Franklin Institute on the Explosions of Steam Boilers: in two parts. Presented by the Franklin Institute of Pennsylvania.

Report of the Managers of the Franklin Institute, in relation to Weights and Measures. Presented by the same.

Observations to determine the Magnetic Dip at Baltimore, Philadelphia, New York, West Point, Providence, Springfield, and Albany. By A. D. Bache, Professor of Natural Philosophy and Chemistry, and Edward H. Courtenay, Professor of Mathematics, in the University of Pennsylvania. Presented by the former.

On the relative horizontal Intensities of terrestrial Magnetism at several Places in the United States. By the same.

Analysis of some of the Coals of Pennsylvania. By H. D. Rogers, F. G. S. London, and Professor Bache, &c. Presented by the latter.

Notes and Diagrams, illustrative of the Directions of the Forces acting at and near the Surface of the Earth, in different Parts of the Brunswick Tornado of June 19th, 1835. By A. D. Bache, Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.

The same author presented also the following papers to the Academy:

Remarks on a Method, proposed by Doctor Thomson, for determining the Proportions of Potassa and Soda in a mixture of the two Alkalies.

Note relating to the hardening of Lime under Water, by the Action of Carbonate of Potassa, &c.

On the comparative Corrosion of Iron, Copper, Zinc, &c. by a saturated Solution of common Salt.

Memoir on the Elastic Force of the Vapour of Mercury at different Temperatures. By M. Avogadro. (Translated by Prof. Bache.)

An Essay on Chemical Nomenclature. By J. J. Berzelius. (Translated from the French, with Notes, by Prof. Bache.)

Historical Notes.

Note of the Effect upon the Magnetic Needle of the Aurora Borealis, visible at Philadelphia on the 17th of May, 1833.

Diagrams for illustrating a Register of the Direction of the Wind.

Experimental Illustrations of the radiating and absorbing Powers of Surfaces for Heat, &c.

Replies to a Circular in relation to the Occurrence of an unusual Meteoric Display on the 13*th of November,* 1834.

Notice of Experiments on Electricity developed by Magnetism.

Experiments on the Efficacy of Perkins's Steam Boilers, or Circulators.

On the alleged Influence of Colour on the Radiation of non-luminous Heat.

Safety Apparatus for Steam Boilers.

Observations on the Disturbance in the Direction of the horizontal Needle during the Aurora of July 10*th,* 1833.

Report of Experiments on the Navigation of the Chesapeake and Delaware Canal by Steam.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1836—1837. No. 2.

December 12.

RICHARD GRIFFITH, Esq., in the Chair.

A paper was read "On the Seals of Ireland, (Phocidæ.)" By Robert Ball, Esq., M. R. I. A.

The author stated the circumstances by which he was led to discover that the seal of most frequent occurrence on the Irish coast was not defined as a British species, together with the subsequent identification of that animal, by Professor Nilsson, as the Halichærus Griseus of his Scandinavian Fauna, (Phoca Gryphus of Fabricius,) found in the Baltic and North Sea. He asserted, however, that the habits of the Halichærus of this country differed so much from those ascribed to it in the Baltic, that it appeared to him not unlikely, on comparison, to prove a distinct species. He showed that the colour of the animal here varied so much from sex, age, season, &c. that it could not be considered of any value as a character of species in the present state of our knowledge of the subject. He alluded to the very small size of the brain compared with that of the genus Phoca, and stated that the intellectual powers bore the same proportion. Mr. Ball then proceeded to show that the simple form of the teeth of Halichærus (approaching closely to those of some species of Delphinus) furnished sufficient grounds for separating it from the genus Phoca; and observed, that the Hali-

chærus may always be distinguished from other seals, by its straight profile, fierce aspect, and greater proportionate length. He mentioned the fact of his having discovered that the specimen in the British Museum, so long known as Donovan's Phoca Barbata, (and the long-bodied seal of Parsons,) is formed of the skin of a Halichærus improperly stuffed; and he noticed the mistakes to which this has given origin.

Mr. Ball next gave instances of the occurrence in this country of the Phoca Vitulina, (*P. variegata Nils.*) which he considered identical with the seal stated by Sir E. Home (Phil. Trans. 1822) to have been killed in the Orkneys, though it appears from the cranium figured as if a few teeth of the P. Groenlandica were inserted into the upper jaw. The author related some anecdotes of the interesting and beautiful specimen now in the Zoological Gardens; contrasted the species in structure and habits with the Halichærus; and expressed his dissent from the statement put forward in Mr. Bell's British Quadrupeds, on the authority of Professor Nilsson, that the oblique position of the molar teeth in P. Vitulina was a specific character of unerring value. He has shown, in fact, that the obliquity in question arose from the insufficient development of the jaws in early life, which contracted the space for the teeth; and that it disappeared long before the skull reached its maximum size, and partially occurred in the young Halichærus.

Mr. Ball then alluded to the seal taken in the Severn, which Professor Nilsson pronounced to be his Phoca Annellata; but which has since been stated, with the Professor's concurrence, to be the P. Groenlandica. He expressed his doubts as to the justness of this conclusion, observing that the Groenlandica was a large species, while the Severn seal was certainly a small one. He further showed that the form of the inter-maxillary bones, where they joined the nasal, was quite sufficient to distinguish it from the specimen figured by Sir E. Home, in the paper before referred to; and

he expressed his belief that the species was still to be determined.

The author concluded by stating his belief in the existence of a fourth seal (probably P. Barbata) on the southern coasts of Ireland, which he had occasionally seen, but never had opportunity of closely inspecting; and finally exhibited a number of sketches illustrative of his paper, showing generic and specific distinctions of external forms, skulls, teeth, cæca, and of the great sinuses of the hepatic veins.

Professor Kane laid before the Academy, specimens of the salts of a new acid, called by him "Xanthomethilic Acid."

The same gentleman stated some conclusions to which he had recently arrived, from the examination of pyroacetic spirit, which he considered to be a new alcohol.

DONATIONS.

Discours sur quelques Progrès des Sciences Mathematiques en France, depuis 1830. Par le Baron Charles Dupin, President de l'Académie. Presented by the Author.

Researches on Heat. (Second Series.) By James D. Forbes, Esq. F.R.SS.L.& E., F.G.S. Presented by the Author.

January 9, 1837.

Rev. B. LLOYD, D.D., Provost, T.C.D., President, in the Chair.

Matthew Barrington. Esq., Arthur E. Gayer, Esq., Sir John Kingston James, Bart., Francis Barker, M.D., William Gregory M.D., F.R.S.E., Edward A. Clarke, Esq., Charles Lambert, Esq., and Thomas Williams, Esq., were elected Members of the Academy.

The Secretary read a letter from the Secretary of the Royal Academy of Madrid, returning thanks for a copy of the Transactions.

Sir William Betham read a letter from the Baron de Donop, of Saxe Meiningen, on the subject of the alleged discovery of the MS. Translation of Sanconiathon's History of the Phœnicians, by Philo Biblius.*

Sir William Betham read a letter from Sir John Tobin of Liverpool, respecting the cast-iron ring money, found on board the wreck of a vessel, and exhibited at the meeting of the Academy in November:—the following is an extract.

"On the subject of the schooner, Magnificent, which was lost somewhere near Cork, some time since:—she was bound to the river Bonney, or New Calabar, which is not far from the kingdom of Benin. The trade to these rivers for palm oil and ivory, is cotton goods, gunpowder, muskets, and a great variety of other articles;—and among them *manillas*, both of iron and a mixed metal of copper and brass, which is the money that the people of Eboe and Brass Country, and all the nations in that neighbourhood, go to market with. On Wednesday next I will send you a manilla of each kind."

Sir John Tobin states the price of the copper manillas to be £105 per ton, and that of the cast iron £22; the former passes, therefore, for about five of the latter. They so perfectly resemble the Irish antique, as to be scarcely distinguishable except by the difference of the material.

Sir William Betham also read a letter from Captain Edward Jones to Samuel Hibbert, M.D., which the latter gentleman transmitted to him, with the sketches there alluded to.

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* An extract from this letter will be given in the next number of the Proceedings.

"The annexed two sketches are taken from a cast of the species of money now at the present day passing current among the Africans. It so strongly resembles what we saw in Ireland, that I thought you might be interested in a copy of it. Mr. Dyson, who was for some years a surgeon on board an African merchantman, brought it with him; and the first opportunity, I shall make inquiries respecting this and other coin used among the natives. I am told that in the country they are made of solid gold, as in Ireland."

Sir William Betham also read an extract from a letter from Mr. Bonomi to T. C. Croker, Esq.

"You ask me for a note on the ring money of Africa; here it is. So little has the interior of the country changed in that particular since the days of the Pharaohs, that to this day, among the inhabitants of Sennaar, pieces of gold in the form of a ring pass current as money. The rings have a cut in them for the convenience of keeping them together; the gold being so pure you easily bend them, and unite them in the manner of a chain. This money is weighed as in the days of Joseph."

These gold rings are so similar in shape to the ancient rings found in Ireland, that the sketch of one accurately represents the other.

It is a remarkable fact that the name *manilla,* which these brass and iron articles still bear in Africa, signifies *money* in the Celto-Phœnician Irish. *Main* is 'value,' 'worth,' and *aillech* is 'cattle,' 'household stuff,' or 'any kind of property.' So that in this respect the derivation is similar to that of *pecunia* from *pecus*. The manillas were, no doubt, introduced into Africa by the same people that brought them to Ireland; and as the Negro nations have changed but little, if at all, they still pass as money by their old Phœnician name.

The Rev. James H. Todd, A. M., M. R. I. A., Fellow of Trinity College, gave an account of a discovery made by Mr. John O'Donovan, of a valuable though imperfect copy, in MS., of the Annals of Kilronan, or Book of the O'Duigenans, a work that had hitherto been supposed to be lost.

This MS. was discovered by Mr. O'Donovan while engaged in preparing a catalogue of the Irish MSS. preserved in the University Library.

The volume is in quarto and, in its original state, consisted entirely of parchment. It is now imperfect both at the beginning and at the end, and has also some intermediate chasms. The first and earliest portion appears to have been transcribed by one Philip Badley, who states himself to have been engaged in the task in the year 1580; but two or three other hands, evidently of the same period, may be observed throughout the volume, as if two or more scribes had been simultaneously engaged in its transcription.

The Chronicle in its present state begins with the year 1014 and ends with 1571. The principal chasms are between the years 1138 and 1170, and also between the years 1316 and 1462. In the former of these chasms, several leaves of paper have been inserted which are entirely blank. The latter has also been filled with paper, on which some very brief entries have been made relating to the years between 1412 and 1462. Many of these entries, however, record merely the date, with the lunar and solar cycles, indiction, and Julian period corresponding. Two copies of this paper portion of the volume are preserved, one of them of a date perhaps a century later than the other. The older appears to have been written in the sixteenth, or early in the seventeenth, century.

Throughout the book several marginal notes occur, which are for the most part summaries of the text, both in Irish and English. The greater part of the English notes are in the hand-writing of Roderick O'Flaherty, the

celebrated author of Ogygia. This fact was ascertained by comparing these entries with the known autograph of O'Flaherty. The volume, therefore, was formerly in the possession of that eminent antiquary.

The book is lettered on the back *Tigernachi continuator;* and has hence been erroneously supposed to be the continuation of Tigernach's Annals, drawn up by Augustin Mac Raith, (Magrath), called by Colgan and others *Mac Raidinus*, a canon of the Augustinian monastery of All Saints in Lough Righ, in the River Shannon, who died A. D. 1405. And as this chronicle extends to the year 1571, Mr. O'Reilly supposed it to include a continuation of Magrath's work.* This error, which the slightest inspection of its contents refutes, was afterwards pointed out by Mr. O'Reilly himself;† and the comparison of the book with a complete copy of the continuation of Tigernach in the University Library, sets the question entirely at rest.

Mr. O'Reilly having satisfied himself that this chronicle was not what it had hitherto been taken for, declares himself unable to say what it should be called; but Mr. O'Donovan has now proved it to be the ANNALS OF KILRONAN, or BOOK OF THE O'DUIGENANS, mentioned by the Four Masters as one of the original sources from which they derived the materials of their celebrated work.

Mr. Todd then stated that extracts from what is called the *Book of Kilronan*, in the hand-writing of Charles O'Conor of Belanagare, are preserved in the Stowe Library; and that a quotation from these extracts given by Dr. O'Conor in his catalogue of the Stowe MSS., was not to be found in the Dublin MS. of the Kilronan Annals. This fact appeared at first sight to create a formidable difficulty in the way of

* Transactions of the Hiberno-Celtic Society, in ann. 1405, p. cxiii.

† See Mr. Mason's Catalogue of the Irish MSS. in Trinity College.

Mr. O'Donovan's opinion. The consideration of it, however led Mr. Todd to conjecture, that the *Book* of Kilronan, from which Charles O'Conor made the extracts in question, could not be the *Annals* of Kilronan, which were in the hands of the Four Masters. Mr. O'Conor describes it as the book of *the church* of Kilronan, and from the extracts he has made from it, it appears to have begun at least with the times of St. Patrick, whereas the Annals of Kilronan, as described by the Four Masters, began with the year 900, and are expressly called by them the *Book of the O'Duigenans*. The one, therefore, was *a church book*, or chronicle kept by the ecclesiastics connected with the church of Kilronan, whereas the other was the family chronicle of the Mac Dermots, compiled by their family bards, the O'Duigenans, of Kilronan. This conclusion is interesting, as acquainting us with the fact, that the *Book of the Church of Kilronan* existed so lately as the year 1728, when O'Conor made the extract from it, which is now in the Stowe Library, and that it may perhaps exist to this day unknown, or under some other name.

The discovery of the Book of the O'Duigenans, or Annals of Kilronan, will be of great importance, if ever the liberality of government, or the contributions of individuals, should supply the means of printing the ancient historical records of this country. To a complete edition of the Annals of the Four Masters, it is essential that as many as possible of the original documents from which they drew their materials should be in our hands. And this discovery supplies us with one of these documents, whose existence was hitherto unknown to Irish antiquarians. Of the ancient annalists, whose works formed the basis of the Annals of the Four Masters, there are now not more than two or three that are not to be found in the Library of the Academy, or in that of Trinity College.

Mr. Petrie exhibited a MS. of the four Gospels, in Latin, of which he had given an account in a paper read some time since before the Academy. This manuscript is said to have been that given by St. Patrick to the first Bishop of Clogher. It is enclosed in a brazen case, of very curious workmanship, on which the circumstances connected with the gift are represented in highly raised figures.

Professor Lloyd communicated to the Academy the continuation of his investigations "On the Propagation of Light in uncrystallized Media."

In the first part of this paper, read on a former evening, the author had expressed his conviction that the problem of wave-propagation in bodies was incompletely solved, unless the action of the material molecules be taken into account. This he has attempted to do in the present continuation, confining himself to the comparatively simple case in which the molecules of the ether and of the body are uniformly diffused.

The differential equations of motion inferred from these considerations contain, each, the displacements of the molecules of the ether and of the body,—with coefficients depending on the masses and distances of the molecules, the law of force to which they are subjected, and the length of the wave. By a particular method of elimination, these pairs of *simultaneous* equations may be reduced each to a single one, of the simple form which occurs in the case of a single vibrating medium, the new coefficient being connected with those of the original equations by an equation of the second degree. The expression for the displacement, then, is of the same form as in the case of a single vibrating medium; but the relation between the coefficients of the time and of the distance, and consequently the velocity of propagation, will be very different.

The quadratic equation above alluded to expresses the relation of these coefficients, or, in other words, the relation between the period of vibration and the length of the wave. When the action of the molecules of the ether and of the body, *inter se,* and on one another, is governed by the same law, this equation is resolvable into simple factors, one of which only seems to belong to the problem, the other giving an expression for the velocity of propagation independent of the length of the wave. The author accordingly proceeds to develop the former of these formulæ, converting the triple sums which it contains into triple integrals, according to the method of M. Cauchy.

Among the consequences deducible from this development is the following:—In the expanded expression for the velocity of propagation, each term consists of two parts, one of which is due to the action of the ether, and the other to that of the body. It is not improbable that there may be bodies for which the first or principal term is nearly nothing, the two parts of which it is composed being of opposite signs, and nearly equal. In this case the principal part of the expression for the velocity will be that derived from the second term; and, if that term be taken as an approximate value, it will follow that the refractive index of the substance must be in the sub-duplicate ratio of the length of the wave, nearly. Now, it is remarkable that this law of dispersion, so unlike anything observed in transparent media, agrees pretty closely with the results obtained by Sir David Brewster in some of the metals. In all these bodies the refractive index (inferred from the angle of maximum polarization) *increases* with the length of the wave. Its values for the red, mean, and blue ray, in silver, are 3.866, 3.271, 2.824; the ratios of the second and third to the first being .85 and .73. According to the law above given, these ratios should be .88 and .79.

Professor Mac Cullagh made a verbal communication on the probable nature of the light transmitted by the diamond and by gold leaf. He conceives that as there is a change of phase caused by reflexion from these bodies, so there is also a change of phase produced by refraction; the change being different according as the incident light is polarized in the plane of incidence, or in the perpendicular plane. Consequently, if the incident ray be polarized in any intermediate plane, the refracted ray should be elliptically polarized; and on examining the light transmitted by gold leaf, this was found to be the case. Of course the same thing is true of the light which enters the other metals, and which is subsequently absorbed. The same remark explains the appearance of double refraction in specimens of the diamond which give only a single image; and it is likely that other precious stones will be found to possess similar properties. Mr. Mac Cullagh has obtained a general formula for the difference of phase between the two component portions of the refracted light—one polarized in the plane of incidence, and the other perpendicular to it. He finds from this formula, that the difference of phase, which is nothing at a perpendicular incidence, increases until it becomes equal to the *characteristic* at an incidence of 90°; and when the light emerges into air, the difference of phase is doubled. The formula has not yet been submitted to the test of experiment.

Mr. Mac Cullagh then read a paper "on the Laws of Crystalline Reflexion and Refraction."

In this paper the solution of the following problem is given for the first time:—

Supposing a ray of light, polarized in a given plane, to fall on a doubly refracting crystal, it is required to find the plane of polarization of the reflected ray, and the proportion between the amplitudes of vibration in the incident, the reflected, and the two refracted rays.

The constructions to which the author has been led by his theory are extremely simple, and may be explained most easily by referring to a paper which he has already published in the Transactions of the Academy, vol. xvii. pp. 251, 252. To avoid circumlocution, he uses the term *transversal*, to denote a right line parallel to the plane of polarization of a ray, and perpendicular to the direction of the ray itself. When the transversal is spoken of as a finite magnitude, its length is understood to be proportional to the amplitude of the vibrations in the polarized ray. Let O (as in the place just referred to) be the point of incidence on the crystal, and OT, OT′, the directions of the two refracted rays, the points T, T′, being on the wave-surface. Corresponding to the points T and T′ on the wave-surface, there are two other points, P and M, on a second surface which is reciprocal to the wave-surface. The points P and M are derived from the points T and T′ by an easy rule which is given in the place before cited. Now if we wish to find in what direction the incident ray must be polarized in order that the ray OT′ may disappear, let us draw, through the point O, a plane A perpendicular to the plane OTP, and parallel to the right line TP, which joins the corresponding points, T, P. This plane A will intersect the planes of the incident and reflected waves in two right lines, which will be the transversals of those waves; so that if the incident ray or wave be polarized parallel to the first intersection, the reflected ray will be polarized parallel to the second intersection, and there will be only a single refracted ray OT. A right line drawn through the point O, perpendicular to the plane OTP, will lie in the plane A, and will be the transversal of the refracted ray OT; and if, measuring from the point O, the lengths of the three transversals represent the amplitudes of the respective vibrations, the transversal of the refracted ray OT will be the diagonal of the parallelogram, whose sides are the transversals of the incident and reflected rays. The prob-

lem is, therefore, completely solved in this case; and it is obvious, that a construction precisely similar will apply to the other case, in which OT′ is the only refracted ray. The plane B, which, in this second case, answers to the plane A in the first case, is perpendicular to the plane OT′M, and parallel to the right line T′M.

If the incident ray be polarized in a direction intermediate between the two transversal directions which give only a single refracted ray, the incident vibration may be resolved into two vibrations parallel to those two transversals. The reflected vibrations arising from each of the component incident vibrations are to be found by the foregoing rules, and then to be compounded.

When the intersection of the planes A and B is perpendicular to the direction of the reflected ray, this ray is polarized parallel to that intersection, whatever be the plane of polarization of the incident ray. The angle of incidence at which this takes place is the polarizing angle.

When the refracted ray OT or OT′ is a normal to the wave-surface, the plane A or B is the plane of polarization of the ray. For example, if OT be the ordinary ray in a uniaxal crystal, the plane A contains the ray OT and the axis of the crystal.

The hypotheses from which Mr. Mac Cullagh has obtained the foregoing laws, are these:—

1. The density of the æther is the same in all media.

2. The vibrations are parallel to the plane of polarization.

3. The *vis viva* is preserved.

4. The vibrations are preserved: that is, the resultant of the incident and reflected vibrations is the same as the resultant of the refracted vibrations.

The author finds that his theory represents very accurately the experiments of Sir David Brewster and M. Seebeck, on the light reflected in air from a surface of Iceland spar.

DONATIONS.

A Description of the Shetland Islands, comprising an Account of their Geology, Scenery, Antiquities, and Superstitions. By Samuel Hibbert, M.D., F.R.S.E., &c. Presented by the Author.

Memoir on the Tings of Orkney and Shetland. By the same Author.

Observations on the Theories which have beeen proposed to explain the Vitrified Forts of Scotland. By the same Author.

Flora Batava, No. 108. By H. C. Van Hall. Presented by the Author.

The American Almanac and Repository of Useful Knowledge, for the Year 1837. Presented by the American Philosophical Society.

January 23.

RICHARD GRIFFITH, Esq. in the Chair.

Captain Portlock read a notice of the occurrence of Anatifa Vitrea,* of Lamarck, in several localities on the Irish coast. He commenced by enforcing the great importance of recording as quickly as possible the first discovery in a new locality of any species of the animal or vegetable kingdom, as tending to perfect the Fauna or Flora of the district in which it is found; and pointed out the value of such local Faunæ and Floræ in estimating the relations and mutual dependencies of co-existing animals and plants, and affording a basis of comparison by which future observers may be enabled to test the probability of new organic beings occa-

* Lepas fascicularis, of Ellis, Montague, and other authors; Lepas dilata, of Donovan.

sionally appearing on the surface of the present earth, in the same manner as they appear to have occurred at very distinct epochs in the more ancient world.

Captain Portlock then cited the various authors who have mentioned this species of the pedunculated division of Lamarck's class, Cirrhipeda, beginning with its first discoverer, Ellis, who figured and briefly described it in his Natural History of Zoophytes, published in 1786. It is there stated to have been obtained in St. George's Channel. It was afterwards found on the western coast of England by Mr. Brier and Mr. Montague, but is still considered there (as stated by Turton in his Conchological Dictionary) very rare. The Rev. Dr. Fleming communicated to the Wernerian Society, between 1811 and 1814, his discovery of the species in considerable abundance on the coast of the Zetland Islands. Lamarck formed his species, vitrea, from a specimen obtained on the shore of Noirmantier, an island off the coast of Poitou, apparently the first noticed in France. He had, however, seen a specimen of the Lepas Fascicularis, sent him by Mr. Leach, and states his opinion that it is only a variety of vitrea. A cluster of this species of cirrhipedæ having been sent to Captain Portlock by one of the Ordnance Survey Collectors, from the north coast of Antrim in the autumn of the last year, he was induced to make further inquiry as to its previously known existence in Ireland, and having mentioned the circumstance to Mr. R. Ball, was informed by him of four cases of its occurrence which he had recorded, viz. on the coast of Youghal in 1819; coast of Clare, 1823; coast of Clare, 1828; coast of Antrim, 1834. These localities, therefore, taken with his own, constitute a very wide range, and show that this species, still considered as very rare on the coast of England, and apparently equally so in France, has been traced round the western shore from the north to the south of Ireland. Specimens of Anatifa Lævis, Lamarck, (Lepas Anatifera, Linn.,)

accompanied those of vitrea. This is a common species all round the Irish coast. Captain Portlock mentioned that Mr. Ball had either in possession, or a record of, the following species of cirrhipedæ, as Irish:

Anatifa Sulcata, (Lepas Sulcata, Mont.,) Youghall; found also by Mr. O'Kelly, near Kenmare.

Anatifa Striata, Lamarck, (Lepas Anserifera, Linn.,) Dublin Bay.

Pollicipes Scalpellum, Lamarck, (Lepas Scalpellum, Mont.,) found by Mr. W. H. Harvey in Dublin Bay.

Cineras Vittata, Leach, Lamarck, (Lepas Membranacea, Turton,) attached to a plank cast on shore near Malahide.

Otion Cuvieri, Leach, Lamarck, (Lepas Aurita, Linn.,) attached with a Cineras to a Balanus. The whole constituting a very large proportion of the pedunculated cirrhipedes, at present known in Great Britain.

Professor Lloyd exhibited to the Academy some modifications which have been recently made in the construction of the Magneto-electric Machine.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1837. No. 3.

February 13.

Rev. F. SADLEIR, D. D., F. T. C. D., Vice-President, in the Chair.

Rev. Thomas Knox, George J. Knox, Esq., and Andrew S. Hart, Esq., F. T. C. D., were elected members of the Academy.

Doctor Gregory read a paper, entitled, "Examination of Eblanine, a substance discovered by Mr. Scanlan, and exhibited by him at the Meeting of the British Association." By Professor Apjohn and Dr. Gregory.

Eblanine is contained in pyroxilic spirit. It is yellow, crystalline, fusible at 318°, volatile in a current of air at 300°, not subliming in a close tube unchanged. It is insoluble in water and alkalies, soluble with a strong yellow colour in alcohol, ether, and concentrated acetic acid. Strong sulphuric acid strikes with it a deep bluish purple colour, soon passing to brownish black. Strong muriatic acid dissolves it sparingly with a very fine and intense purplish red colour, which also slowly passes into brownish black. Nitric acid dissolves it, and from the solution water separates a yellow solid, which, at a certain temperature, is decomposed suddenly with a very feeble explosion. Chlorine converts it into a dark resinous matter.

Eblanine is anhydrous, and contains no nitrogen.

The mean of 4 analyses gave as the composition in 100 parts,

Carbon, ...	75.275
Hydrogen, . . .	5.609
Oxygen, . . .	19.116

The composition, calculated according to the formula $C_{21} H_9 O_4$, would give

Carbon, ...	75.79
Hydrogen, . . .	5.30
Oxygen, . . .	18.91

But as we have as yet no means of ascertaining the atomic weight of eblanine, this result must be viewed merely as an approximation.

Eblanine cannot be confounded with any known substance, and must rank as a curious addition to the list of compounds produced in the destructive distillation of wood; to which must also be added, aldehyd, a substance lately discovered by Liebig, but first pointed out as existing in pyroxilic spirit, by Mr. Scanlan, who obtained it before the discovery of Liebig was known in Dublin.

Sir William Betham read the first of a series of papers "On the Cabiric Mysteries and Phœnician Antiquities."

In this paper the author stated his conviction that the Cabiri were a secret society or brotherhood, who concealed their acquirements in science and the arts from all but the initiated; that this society originated with the Phœnicians, and was for a very long period confined to that people and their colonies; that the arts of navigation, mining, &c., the science of astronomy, and indeed all other branches of knowledge with which they were acquainted, were enveloped by them in mystic fables and allegories, to conceal them from the vulgar; and that from these was derived the whole system of mythological theology of the Greeks and Romans.

The word Cabiri, in Celto-Phœnician, literally means *the confederacy* or *brotherhood of science. Cabar* is *a confederacy* or *secret society, i, of science.* The four *degrees* or *steps of initiation* into this order, were named *Axieros, Axiochersa, Axiochersus*, and *Camillus*, or *Casmillos.* These were made deities by the Greeks, the Phœnicians themselves encouraging or perhaps propagating an error, the explanation of which was part of the secrets of the confederacy. The confederacy itself originated at a very early period of Phœnician history, and seems to have partaken of the essence of the policy by which that people aimed to keep the world in ignorance, and to carry on in secret their extensive operations in commerce, navigation, and mining; the secrets of these arts being enveloped in terrible mysteries, which deterred the ignorant and unenlightened from interference. By these means they succeeded in securing to themselves for ages the exclusive sovereignty of the seas, the entire commerce, and the greater part of the wealth of the world.

The discovery of the identity of the Celtic and Phœnician tongues has led to the exposition of the true meaning of the names and nature of these imaginary Cabiric deities, which the author explained as follows :—

Axieros.—The first step.—*The initiation by the shedding of blood.*

Axiochersa.—The second degree.—*The communication to the ear of the more important secret of silence.*

Axiochersus.—The third degree.—*The communication to the ear of the silent secrecy of experience.*

Camillus, or *Casmillos.*—The fourth degree.—*The perfection of all knowledge.*

Vulcan is said to have been the father or founder of the Cabiri. This name in Celtic signifies *the profound metallurgist, smith,* or *worker in metals; Fol Gaun,* or *Bal Gaun, the lord smith.* It is also worthy of remark, that in Sanconia-

thon's account of the descent or pedigree from the first man, Vulcan stands contemporary with *Tubal Cain* of the Scriptures, who was the "instructor of every artificer in brass and iron;" and this last name is of the same signification in the Celto-Phœnician, i. e. *the celebrated lord smith*, or *metallurgist.*

The author concluded by observing, that such members of the Academy as were Freemasons must be struck by analogies which he could not more clearly explain.

DONATIONS.

A copy of the Ordnance Survey of the County of Cavan, in 46 sheets. Presented by Lieut. Colonel Colby.

Asiatic Researches, Vol. 20, Part I. Presented by Mr. Princep.

Anglorum Feriæ, Englandes Holydayes, &c. Presented by W. H. Fitch, Esq.

Transactions of the Institution of Civil Engineers, Vol. 1. Presented by the Council of the Institution of Civil Engineers.

Letters on the Conduct of Charles Purton Cooper, Esq., Secretary to the Commission of Public Records, and on the General Management of the Commission. By Mr. Henry Cole. Presented by C. P. Cooper, Esq.

Letters from Eminent Historical Writers, relating to the Publications of the Board of Commissioners on the Public Records. Presented by the same.

Observations, Letters, and Opinions of the Commissioners, on the Constitution and Duties of the Record Commission. Presented by the same.

February 27.

Rev. B. LLOYD, D. D., Provost, T. C. D., President, in the Chair.

Mr. Petrie read a paper, being an account of a valuable Irish MS. belonging to the Earl of Roden, (of which a transcript has been recently made for the Academy, under the direction of Mr. Petrie, by Mr. Eugene Curry,) with a biographical notice of its author.

This MS., which is of great celebrity among Irish scholars and historians, was compiled between the years 1650 and 1664, by Duald Mac Firbis, from various ancient historical works many of which are now lost, and contains the most complete historical account of the several tribes who made settlements in Ireland and Scotland, with genealogies of all the principal families descended from them. Its compiler was the last of the hereditary antiquaries of Lecan Mac Firbis, in the county of Sligo, by whom the celebrated MS. called the Book of Lecan, now in the Library of the Academy, was compiled in the fourteenth and fifteenth centuries; and it is a valuable supplement to the genealogical portion of that great work, the pedigrees being, in most instances, continued down to the time of the writer. It also contains a vast quantity of matter not to be found in any other works, as historical and topographical poems, &c., but particularly an account of the Danish and Anglo-Norman families, which is of inestimable value.

The MS. is a small thick quarto on paper, containing about 1000 pages, and is wholly in the hand-writing of Mac Firbis, with the exception of a small portion in the hand-writing of Michael O'Clery, the chief of the celebrated annalists popularly called the Four Masters. The transcript made for the Academy agrees in every respect with the original, with which it has been compared most carefully by

Mr. O'Donovan. It is, however, more perfect; as many chasms caused by stains and other injuries have been supplied from abstracts of the work made by the compiler himself, and many corrections and much additional matter found in those abstracts have been inserted. The Academy's transcript may therefore be considered the only perfect copy of the work now existing.

Professor Lloyd read a note on the Aurora Borealis of the 18th inst., of which the following is an extract:—

"At a quarter past ten o'clock, on the night of the 18th inst., my attention was called to a remarkable ruddy appearance in the eastern part of the sky, which, at first view, seemed to arise from the reflexion of a fire. On a more attentive examination, however, it was soon evident that the appearance was purely meteoric. It was, in fact, an auroral phenomenon, though of a very peculiar kind.

"It was bright moonlight, and Mars had just appeared after his occultation by the moon. The sky was entirely without clouds; but the northern, eastern, and western segments were covered with a curtain of diffused Aurora, resembling a luminous vapour. This curtain was lifted from the horizon on the east and west, and exhibited a deep blue sky. But the distinguishing appearance was, that large masses of this light, especially towards the east and north-east, were of a *blood-red* colour, which presented a vivid contrast to the blue of the sky beneath. A large patch of this red light, about 40° from the horizon to the eastward, was the most remarkable. It continued distinctly visible for upwards of half an hour; and its motion was so rapid that in this time it had advanced from about due east to a point nearly south-east.

There was a mass of *white* streamers to the north, which reached nearly to the zenith, and pointed somewhere between the magnetic and due north. At half past ten o'clock,

a brilliant and well defined stream of light of the blood-red colour appeared a little to the south of west, and seemed to be a disjointed portion of the eastern red mass. A few minutes after its appearance, a large mass of white auroral light began to rise rapidly from the northern horizon; at the same time the northern streamers became much more vivid, and took a fan-like appearance, converging to a point not far from the zenith. There was no appearance, however, of *Corona.* Shortly after, (about 10^h. 40′), a portion of the light of these streamers, about midway between *a* Ursæ and Polaris, assumed the unusual blood-red tint, and continued of this colour for several minutes.

"Before 11 o'clock all the peculiar appearances had nearly gone; and there remained nothing but the faint luminous clouds, with light streamers to the N. N. W. These streamers were still playing at 12 o'clock, and extended from the zenith to within about 30° of horizon.

"The thermometer stood at 38° fahr., and the barometer at 29.786 inches. The wind was dry and piercing."*

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* The following note, by Mr. Bergin, supplies the account of the early part of the phenomenon:—

"On alighting at the Dunleary station at 7 o'clock, (from the Railway,) we observed a magnificently coloured crimson Aurora as a broad mass to the westward; and our first impression for a moment was, that it was the light from one of the engine furnaces reflected from a cloud of steam. It extended from near the horizon towards the zenith, with frequent flashes or streamers within itself. From the main mass, round by the north, and onward to the east, the whole sky had a crimson or carmine tint; and were it not for the brilliant moon (near the full) I do believe the splendour would have equalled any I have ever heard of. * * * * The Aurora assumed the general appearance of an arch; the first observed mass to the westward being one leg which faded away toward the zenith, where there was a steady circular patch of great brilliancy of colour, and from thence, separated by a small interval, was a faint limb descending to the eastern horizon. * * * * These appearances continued with scarcely any change till near 8 o'clock. About 9 o'clock the general appearances were much the same, save that the eastern limb of the arch was not visible, and the western much more intensely coloured, and like a steady column. * * * * Throughout, its limits had been well defined; and it was perfectly transparent, stars of the third, and perhaps the fourth magnitude being seen through it."

Professor Lloyd read a note on a new electrical phenomenon.

The Rev. J. H. Todd, F. T. C. D., gave a short account of a MS. of the four Gospels, of the seventh century and in Irish characters, which is preserved in the Library of his Grace the Archbishop of Canterbury at Lambeth. The volume is a small quarto, in the minute hand called *Caroline,* common to all Europe in the reign of Charlemagne, but now used only in Ireland, and known as the Irish character. The present volume appears to have belonged to Maelbrigid Mac Dornan, or Mac Tornan, who was Archbishop of Armagh in the ninth century, and died A. D. 925. By him it was probably sent as a present to Athelstan, King of the Anglo-Saxons, who presented it to the city of Canterbury. These facts are inferred from the following inscription in Anglo-Saxon characters, (and in a hand of the ninth or beginning of the tenth century,) which occurs on a blank page immediately following the genealogy in the first chapter of St. Matthew.

✠ MÆIELBRIDVS. MAC.
DVRNANI. ISTVM. TEXTVM.
PER. TRIQVADRVM. DŌ.
DIGNE. DOGMATIZAT.
✠ AST. AETHELSTANVS.
ANGLOSÆXANA. REX. ET.
RECTOR. DORVERNENSI.
METROPOLI. DAT. PER. ÆVVM.

The former part of this inscription Mr. Todd professed himself unable to translate to his own satisfaction. *Textus,* in the Latinity of the middle ages, is a term frequently employed to denote the Four Gospels; but *dogmatizare,* in the same dialect, is generally used in a bad sense, *to assert erroneous or heretical opinions,* a signification which it cannot well bear here: *triquadrus,* when used as an adjective,

is equivalent to *tripartitus, trisected,* and its use as a substantive is rare.

The mention of Maelbrigid Mac Dornan, in connexion with the present volume, might be relied upon as sufficient evidence of its Irish origin; but there is proof of this fact still more conclusive. In the lower margin of the page, which contains the account of our Lord being compelled to bear his cross, (from ver. 24 to 32 inclusive, of the 27th chapter of St. Matthew,) there is the following note in the Irish language, and in the hand-writing of the original scribe:

mōṙ aſſáṙſa ꝼ coıṁdıa nıme ⁊ talman

The second word is probably a contraction for aſſanaṙ ſa, or as it would now be spelt, eaſonoıṙ ſa; the whole therefore, in modern orthography and without contractions, is to be read as follows:

Moṙ eaſonoıṙ ſa ꝼoṙ coıṁdıa nıṁe aᵹuſ talṁan.
Great dishonour this to the God of heaven and earth.

The discovery of this MS., and the satisfactory proof which these facts afford of its Irish origin, are important, as adding another to the many instances with which we are already acquainted, of the employment of Irish scribes in the transcription of the Scriptures during the sixth and seventh centuries. It is now well ascertained that almost all the sacred books so highly venerated by the Anglo-Saxon Church, and left by her early bishops as heirlooms to their respective sees, were obtained from Ireland, or written by Irish scribes.

DONATIONS.

The Mining Review, and Journal of Geology, Mineralogy, and Metallurgy. Conducted by Henry English, Esq., F. G. S., &c. No. IX. (New Series.) Presented by the Editor.

March 16. (Stated Meeting.)

Rev. B. LLOYD, D. D., Provost T. C. D., President, in the Chair.

This being the day of the annual election, the following Officers and Members of Council were chosen for the ensuing year:

President—Rev. Bartholomew Lloyd, D. D.
Treasurer—Thomas Herbert Orpen, M. D.
Secretary—Rev. Joseph Henderson Singer, D. D.
Secretary to Council—Rev. Richard Mac Donnell, D. D.
Secretary of Foreign Correspondence—Sir Wm. Betham.
Librarian—Rev. William Hamilton Drummond, D. D.

Committee of Science.

Rev. Franc Sadleir, D. D., Rev. Richard Mac Donnell, D. D., Sir William Rowan Hamilton, Rev. Humphrey Lloyd, James Apjohn, M. D., James Mac Cullagh, Esq., Captain Portlock, R. E.

Committee of Polite Literature.

The Archbishop of Dublin, Rev. Joseph Henderson Singer, D. D., Andrew Carmichael, Esq., Samuel Litton, M. D., Rev. William Hamilton Drummond, D. D., Rev. Charles Richard Elrington, D. D., William West, M. D.

Committee of Antiquities.

Rev. James Henthorn Todd, Thomas Herbert Orpen, M. D., Hugh Ferguson, M. D., Sir William Betham, George Petrie, Esq., Rev. Cæsar Otway, Dean of St. Patrick's.

Professor Kane read a paper, entitled "Researches on the Combinations derived from Pyroacetic Spirit."

In order to understand the relation between the following bodies and pyroacetic spirit, the atomic weight of the latter

must be considered as representing four volumes of vapour, and its formula written $C_6H_6O_2$. It has been found to give a series generally analogous to that of ordinary alcohol, and Professor Kane proposes for it the name *Mesitic Alcohol.*

By means of sulphuric acid there is obtained a fluid colourless, of an alliaceous odour, boiling at 276. F. and having the composition C_6H_4, to which is given the name *Mesitylene.*

By acting on mesitic alcohol with perchloride of phosphorus there is generated *phospho-mesitylic acid,* and a compound fluid heavier than water, which has the formula C_6H_5Cl; and, by the decomposition of the latter by means of potash, a body C_6H_5O. These may be considered either as containing *Mesitylene,* or a hypothetic radical *Mesityl,* thus:

C_6H_5+O. Oxide of Mesityl.	C_6H_4+HO. Hydrate of Mesitylene.
C_6H_5+Cl. Chloride of Mesityl.	C_6H_4+HCl. Muriate of Mesitylene.

By the action of phosphorus and iodine on mesitic alcohol, there is produced an *iodide of mesityl,* having the formula C_6H_5I.

Oxide of Mesityl unites with sulphuric acid in two proportions, forming the sulphate and the bisulphate of mesityl; both of these are acid, and unite with bases forming well characterized salts.

The salts of the former are called *sulphomesitylates,* and of the latter *persulphomesitylates;* and a very anomalous character in these salts is, that the quantity of the inorganic base is such as could neutralize the whole of the sulphuric acid which they contain. Thus the sulpho-mesitylate of lime has the formula

$$SO_3+C_6H_5O+CaO+HO;$$

and the persulphomesitylate of lime

$$2SO_3 + C_6H_5O + 2CaO + HO.$$

When an excess of phosphorus is used in the process for making iodide of mesityl, there is obtained in the retort a white matter in silky crystals, which dissolves in water, is very acid, and forms well characterized salts, which, when heated, take fire and burn with a well marked flame of phosphorus. This acid is termed *hypophosphomesitylous acid;* and the formula of the *hypophosphomesitylate of baryta* is

$$P_2O + C_6H_5O + BaO + HO.$$

In the decomposition of mesitic alcohol by perchloride of phosphorus there is obtained an acid which gives a soda salt crystallizing in rhombs which contain water of crystallization. Their formula is

$$P_2O_5 + NaO + C_6H_5O + 6HO.$$

Professor Kane stated that he had obtained also the aldehyd of the mesityl series, as well as bodies procured by the action of chlorine and iodine on mesitylene, and the acids which are generated by the oxidation of mesitic alcohol, the history of which bodies shall form the subject of another paper.

The empyreumatic oil, which is produced in small quantity when mesitic alcohol is prepared by distilling acetate of lime, has been submitted to analysis by Professor Kane, and its composition found to be $C_{10}H_8O$. It therefore belongs to the family of which oil of turpentine is the base, and is polymeric with camphor, and the pinic, sylvic, and copaivic acids.*

Dr. Apjohn read a paper "On the Specific Heats of the Aeriform Fluids."

The first part of this communication was an analysis of, and some critical remarks upon, the labours of those who

* In this abstract the atomic weights are taken, Hydrogen = 1. Oxygen = 8. Carbon = 6, 13.

had preceded the author in the same investigation, particularly those of Dulong. Dr. Apjohn's own method was then detailed. In a paper read by him before the Academy in April, 1835, the equation* $f'' = f' - \frac{48ad}{e} \times \frac{p}{30}$ was proved to include the solution of the dew-point problem. But the factor a in this expression, which is obviously equal (when the air or gas is dry, or in other words, when $f''=0$) to $\frac{f'e}{48d} \times \frac{30}{p}$, is the specific heat under a given volume of the gas which is supposed to be the subject of experiment. Hence if f' and d be determined for the various aeriform fluids by observation, their relative capacities for caloric can be compared. Such is the principle of the method.

Two distinct series of experiments were then detailed, from the second of which, as comprehending those which he conceives to be most accurate, the author has deduced the following table of specific heats:

Specific Heats of equal Volumes.

Atmospheric Air, ...	1.000
Nitrogen, ...	1.048
Oxygen, (by calculation,) . .	.808
Hydrogen, ...	1.459
Carbonic Acid, ...	1.195
Carbonic Oxide	.996
Nitrous Oxide, ...	1.193.

Dr. Apjohn conceives himself justified in drawing from his researches the following conclusions:

1°. All gases have not under equal volumes the same specific heat.

2°. This law is not even true of the simple gases.

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* $d = t - t'$ the difference of the temperatures shown by a wet and dry thermometer, and f' is the elastic force of vapour at temperature t'.

3°. There does not appear to be any simple relation between the specific heats of the gases, and their specific gravities or atomic weights.

A paper was then read "On some remarkable Salts, obtained by the action of Ferrocyanide of Potassium on Sulphovinates and Sulphomethylates."* By William Gregory, M. D., F. R. S. E., &c.

The Committee appointed to examine the Treasurer's Account reported as follows:

"Examined the above Account,† with the vouchers produced, and found it to be correct; and we find that there is a balance in bank of £284 6*s*. 5*d*., and in the Treasurer's hands £110 16*s*. 1*d*., making a total balance of £395 2*s*. 6*d*. sterling.

"(Signed,)

"FRANC SADLEIR,
"C. R. ELRINGTON.

"*Feb. 20th*, 1837."

"The Treasurer reports that there are the following portions of Stock in the Bank of Ireland to the credit of the Academy:

"£1500 in the 3 per Cent. Consols.

"£1500 in the 3½ per Cent. Government Stock, being the Cunningham Fund.

"(Signed,)

"FRANC SADLEIR.

"*Feb. 20th*, 1837."

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* An abstract of this paper will be given in the next number of the Proceedings.

† Entered in the Treasurer's Book.

DONATIONS.

Observations on the Evidence taken before the Committee of the House of Commons, on the Record Commission in 1836, and the Report so far as it refers to the Irish Records. By Sir William Betham, Ulster King of Arms, &c. &c. Presented by the Author.

An Oration on the Important Advantages derivable from Philosophical Instruction. By Henry W. Dewhurst, Esq. Presented by the Author.

A Practical Treatise on the Management and Diseases of Children. By Richard T. Evanson, M. D. Presented by the Author.

The following is the extract from the letter of the Baron de Donop to Sir William Betham, referred to in the last number of the Proceedings:

"Our literati in Germany have been of late much excited and interested by the alleged discovery of the MS. Translation of the History of the Phœnicians, by Philo Biblius, now printing at Bremen. It is generally considered a modern fabrication; but at the same time it is not easy to say by whom. Time will, at no very distant period, decide the question, as upwards of 100 pages of the Greek text have been already printed.

"For myself, I am inclined to think it genuine. A close and careful examination of a portion which has appeared at Hanover, has convinced me that no fabricator could have formed that work, unless he had been profoundly acquainted with the writings of Vallancey, O'Connor, your own works, and those of all others who have asserted the identity of the Phœnician Punic language with that of Ireland; for it is that tongue which is recognized in all the names, almost without exception, which in the mouth of Sanconiathon ought to be Phœnician.

"The most surprizing fact of all is, that in the Chronicles of O'Connor,* which is a book almost unknown in Germany, are to be found accordances not to be mistaken. For instance, what the Chronicles call *aoi-magh*, Sanconiathon calls *Ma thai*. O'Connor says aoi-maġ, a flat country, or region of plains, and *Mathai-Bal* is the first king of the Syrian Phœnician plains of Sidon, according to Sanconiathon. His name, therefore, is nothing more than *Magd-ai-Bal*—and, as in the Chronicles, this *aoi-mag* is the Sidonian Hamath of the ancients—the same Mathai-Bal of Sanconiathon, who caused to be constructed the fortress of *Hamath* on the plains, to defend himself against the neighbouring mountaineers.

"*Maol*, in the Chronicles, is the name of one of the kings of the Gael. The same name appears on the famous Lybian stone of Tucca. Sanconiathon places *Bi-maol* at the head of the kings of Sidon, and his descendants are called *O-Christo-bi-mal*, which is evidently nothing more than ceart-o-be-maol.

"Between 1020 and 1008, B. C., the Chronicles mention Iat-ram, king of Phœnicia, a conqueror, jealous of the dignity of his empire, to whom all the natives of Spain were tributary. At the same period, according to Sanconiathon, there reigned a king of Phœnicia of the same name, *Joram*—the *Hiram of Solomon*—and that Joram was not only master of the west, but extended his rule to the Isle of Ceylon.

"The most interesting portion of all Sanconiathon, is the Phœnician periplous, in which is set forth an enumeration of the Phœnician colonies, extending to the Canary Islands, with their sea and land forces, made by order of Joram."

* The Chronicles mentioned by Baron de Donop are the Chronicles by Mr. Roger O'Connor, which are nothing more than a paraphrastic version of the Milesian story.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1837. No. 4.

March 16.

(*Continued from last Number.*)

"On some remarkable Salts, obtained by the action of Ferrocyanide of Potassium on Sulphovinates and Sulphomethylates." By William Gregory, M.D., F. R. S. E., &c.

When ferrocyanide of potassium is added to sulphovinate of lime, a precipitate appears, which, when heated, gives off hydrocyanic ether. This salt (called A) contains iron, calcium, potassium, cyanogen, and the base of ether.

The mother liquid is found to contain a salt B, very soluble in water and alcohol, which, also, on being heated, yields hydrocyanic ether. The ingredients of B are sulphuric acid, potash, ether, and cyanogen.

In order to avoid the confusion which might result from the use of a salt of lime, (as Mosander has shown that ferrocyanide of potassium produces in the salts of lime, generally, a precipitate consisting of iron, calcium, potassium, and cyanogen,) the author next tried sulphovinate of potash. By the action of ferrocyanide of potassium on this salt he got a salt C, corresponding to A, but different; and another salt D, identical with B.

When sulphomethylate of lime was employed, two salts E and F were obtained, exactly analogous to A and B: and by employing sulphomethylate of potash he got G, corresponding to E, and H, identical with F.

As it seemed likely that the study of any one of these reactions would explain all the rest, the author began with the analysis of G and H, of which he had a larger supply than of the others.

G is lemon yellow, transparent, soluble in water, insoluble in alcohol, crystallizing in square tables much resembling those of ferrocyanide of potassium. By exposure to a heat of 212°, it loses 13.5 per cent. water of crystallization, and becomes opaque. More strongly heated it is decomposed, giving off hydrocyanate of methylene, $= C_2 H_3 Cy$ or $Me\, Cy$. The analysis corresponds with the formula $4\, K\, Cy, 3\, Fe\, Cy, M\, Cy, 8\, Aq$.

H is white, very soluble in water and alcohol, crystallizing in square shining tables. It closely resembles sulphomethylate of potash, but differs from it in being anhydrous, in containing cyanogen, and in yielding hydrocyanate of methylene when decomposed by heat. Its analysis agrees with the formula $6\, S\, O_3, 3\, K\, O, M\, O, M\, Cy$.

If 3 equivalents of ferrocyanide of potassium be supposed to act on 3 of sulphomethylate of potash there is the following equation:

3 equiv. Ferrocyanide		3 equiv. Sulphomethylate
$6\, K\, Cy, 3\, Fe\, Cy$	$+$	$6\, S\, O, 3\, K\, O, 3\, M\, O =$
1 equiv. G		1 equiv. H
$= 4\, K\, Cy, 3\, Fe\, Cy, M\, Cy$	$+$	$6\, S\, O_3, 3\, K\, O, M\, O, M\, Cy$

$+ 2\, K\, O$. *i. e.* 2 equiv. potash. In conformity with this explanation, the liquid in which G crystallizes is alkaline.

If this explanation be admitted, it will of course apply, *mutatis mutandis*, to the salts A B, C D, E F. The author, however, is not yet satisfied that the salts which he analyzed may not have been mixtures, perhaps in definite proportions. No doubt can be entertained that new salts have been formed, but the close resemblance between their properties and those of the salts which yield them, renders the task of purifying and analyzing them one of great difficulty.

(*To be continued.*)

April 10.

Rev. B. LLOYD, D. D., Provost T. C. D., President, in the Chair.

Rev. Charles William Wall, D. D., F. T. C. D., Robert William Smith, M. D., and William Armstrong, Esq., were elected Members of the Academy.

A paper was read "On a new variety of Alumn," by James Apjohn, M. D., M. R. I. A., Professor of Chemistry in the Royal College of Surgeons, Ireland.

This paper commenced with a brief description of the physical characters and chemical properties of the mineral in question, which was found about 600 miles to the north of the Cape of Good Hope, near Algoa Bay, where it occurs in strata whose aggregate thickness is about twenty feet. The specimen described is composed of transparent threads or fibres, exhibiting a beautiful silky lustre, and in appearance closely resembling satin-spar or the finer forms of amianthus. In taste, solubility in water, and other properties, it corresponded with ordinary alumn. It was also easily shown to contain sulphuric acid and alumina, but in addition it contained a base which, though precipitated like alumina by potash, was not redissolved by an excess of the alkali. This, upon examination, turned out to be protoxide of manganese. There was no alkali, but about one per cent. of sulphate of magnesia.

In the first attempt at effecting the analysis of the mineral it was found that alumen and protoxide of manganese could not be separated perfectly by potash, as some of the oxide was taken up by the alkali, while a considerable quantity of alumen was left behind with the oxide. The author explained a method of overcoming this difficulty, the particulars of which are given in detail in the paper. The fol-

lowing are the results—the numbers in column (2) being the quotients got by dividing those in column (1) by the respective atomic weights:

	(1)	(2)	(3)
Sulphuric Acid, . . .	32.79	.817	4.000
Alumina, ...	10.65	.414	2.026
Oxide of Manganese, .	7.33	.205	1.003
Sulphate of Magnesia, .	1.08		
Water of Crystallization,	48.15	5.350	26.315
	100		

The numbers in column (3) being almost exactly the integers, 4, 2, 1, and 26, show that the substance analyzed is a true alumn, having, as respects its acid and bases, the same formula

$$(3SO_3, Al_2\,O_3 + SO_3, MnO + 26HO)$$

with all the known species of that genus, and the same number of atoms of water with soda alumn. It differs from all those previously known in containing no alkali, this being replaced by protoxide of manganese. As an additional peculiarity Dr. A. observed that it did not appear susceptible of assuming the octohedral form.

The paper concluded with some remarks upon the probable existence of an alumn containing no metal but manganese, and upon certain difficulties in the doctrines of isomorphism, suggested by some of the varieties of this class of salts.

Captain Portlock brought under the notice of the Academy some peculiar habits of the Otus Brachyotos, or short-eared owl, lately observed by Captain Neely, whilst collecting for the Ordnance Survey of Ireland.

This species of the sub-genus otus being migratory, is much rarer than the otus vulgaris, or long-eared owl, and it differs from it in many striking respects, such as the small size of the elongated feathers, commonly called ears, which

in this species can only be discerned when the bird is living, and in its tendency to diurnal habits. But in the instance now recorded it exhibits other peculiarities of habit which afford a still more remarkable line of distinction. The point of Magilligan, forming the Derry side of the opening of Lough Foyle to the sea, is studded at its extremity with numerous sand hillocks, in which the rabbits burrow and the sheldrakes lay their eggs, as in other similar localities. But here a new occupant for the burrows of the rabbits appears in the otus brachyotos. These birds are regular in their autumnal appearance, and are seen to sit at the openings of the burrow-holes, and to run into them when disturbed.

Captain Portlock having directed further attention to the fact, and pointed out the necessity of guarding against any source of fallacy, the truth of the first statement was fully established, more than one having been shot on emerging from the holes, and another actually caught in a trap at the mouth of a hole when endeavouring to make his escape. This interesting fact naturally recalls to recollection the stria cunicularicis of America, described by Say; and Captain Portlock pointed out the great value of characteristic traits of habit in elucidating classification, and suggested the peculiar importance of those described in his paper, in affording a link of resemblance between the stria cunicularicis and the otus brachyotos, and thereby facilitating the determination of the true place, in natural classification, of the former, hitherto considered doubtful.

The Secretary communicated the substance of a paper "On the Conic Sections," by James Booth, Esq.

The methods hitherto adopted in deducing the central and focal properties of the conic sections, from arbitrary definitions having appeared to the author defective in geometrical elegance, he has endeavoured in this paper to derive

them from new definitions, of which the following may be considered the principal:

1. If two spheres be inscribed in a right cone touching the plane of a conic section, the points of contact are called *foci*.

2. The radical plane of these two "focal spheres" intersects the major axis in a point called the *centre*.

The property from which the definition of a focus here given is derived, although known for several years, has not been hitherto applied further than to show that this point is identical with the focus as usually defined.

By the help of the above definitions, and of the simplest elementary principles, the central and focal properties already known have been deduced, generally in one or two steps, and several new theorems have been likewise discovered in the development of the method.

A paper "On Fluorine," by G. J. Knox, Esq., and the Rev. Thomas Knox, was read by Dr. Apjohn.

The authors, having taken a summary view of all the researches on fluorine up to the date of the commencement of their experiments in April, 1836, proceeded to describe the vessels of fluor spar which they used in their first experiments, and exhibited those which were latterly found best adapted for examining the gas. These vessels were of fluor spar lapped with iron wire for the purpose of equalizing the temperature, so as to prevent the vessels from splitting on a sudden application of heat. In place of a flat cover for the vessels, fluor spar receivers were used, the cavities of which were filled with ground stoppers of the same material. On moving the receivers over the mouth of the vessel the stoppers fall in, and their places are occupied by the gaseous contents of the vessel. On the top of each of the vessels is placed a flat slab of fluor spar, which answers the purpose of a table, upon which the receivers of the gases

can be moved. On the slab are four small depressions, in which are placed the substances upon which the action of the gas is to be observed, and over which the receivers, when filled with the gas, can be slid. In opposite sides of these receivers are drilled holes, into which are fitted, air tight, clear crystals of fluor spar, through which the colour of any gas in the receiver may be distinctly observed. The vessels are supported on a stand over a lamp.

On heating pure fluoride of mercury in these vessels with dry chlorine they obtained a colourless gas, (as seen through the fluor,) having a heavy smell not pungent or irritating, and thereby easily distinguished from chlorine or hydrofluoric acid. When exposed to the air, it does not fume, as would be the case were the slightest trace of hydrofluoric acid present. The inside of the vessel is found coated with crystals of corrosive sublimate. The gas does not extinguish ignited phosphorus or red hot iron wire, and consequently is (as Sir H. Davy conjectured) a supporter of combustion. It detonates with hydrogen, forming hydrofluoric acid. Placed over water, the solution (if such) has all the properties of hydrofluoric acid, i. e. acts on glass, reddens litmus, and gives precipitates with lime and barytes. Placed over dry litmus and Brazil wood paper, the former is reddened, and the latter turned yellow; in no instance are they bleached. When a receiver of the gas is placed over wet glass, the glass is strongly acted upon; when the glass is carefully dried, the action is not so strong as before. When a small piece of dry glass is placed in a perforation in the interior of the receiver, the glass is acted upon, but not more so than when fluoride of mercury alone is in the vessel, from which they conclude that fluorine does not act on perfectly dry glass.

To ascertain the action of the gas on metals they found it necessary to try the separate effects of hydrofluoric acid, sublimed fluoride of mercury, and bichloride of mercury, in order to distinguish the action of fluorine from that due

in which the nodule and the matrix are of different materials. The present structure would appear to have been produced by the ejection of the trap in a fluid state under the sea; masses of which, cooling in their passage, fell again into the liquid bed, and being enveloped, were heated nearly to the temperature of the mass, and so adhered without losing their outline. Where several fell together, and were exposed to subsequent pressure, they would present the flattened appearance before described; and when more deeply enveloped, and thus subjected to a higher temperature, the nodular structure would again vanish by their complete fusion.

It is even conceivable that the most capriciously varied parts of this and other trap rocks may owe their origin to the soldering together of nodules of heterogeneous matter, projected from different depths, or at different times, or subjected to successive coolings and heatings.

Professor Kane read a paper entitled "Researches on the Compounds derived from Pyroacetic Spirit." (Second Series.)

When dry chlorine gas is passed into pure mesitylene, $C_6 H_4$, muriatic acid is given off, and a compound body, solid, in white prismatic crystals, is formed, giving on analysis the formula $C_6 H_3 Cl$. A yellow substance obtained by the action of iodine on nascent mesitylene, but in too small a quantity for analysis, is considered to be $C_6 H_3 I$.

When mesitylene is treated with nitric acid, copious red fumes are given off, and a very heavy thick fluid obtained, which gives on analysis the formula $C_6 H_4 O_2$. This fluid absorbs ammonia, and forms therewith a compound soluble in water, and giving with most metallic solutions insoluble precipitates.

If pure mesitic alcohol be heated with nitric acid, there is

a very violent reaction, and an explosive decomposition, if distillation be attempted; but by diluting with water a heavy fluid is produced, which gives, on analysis, unsatisfactory results, owing, in the first place, to its decomposing with an explosion when heated, and, secondly, to its being always mixed with some of the substance last described: the results obtained indicate, however, as very probable the formula $C_6H_3NO_4$.

To connect the above results, Professor Kane proposes to assume as radical the body C_6H_3, to which he gives the name of pteleyl. Then

$C_6H_4 = C_6H_3 + H$. Hydruret of pteleyl or mesitylene.

$C_6H_3Cl = C_6H_3 + Cl$. Chloride of pteleyl.

$C_6H_3I = C_6H_3 + I$. Iodide of pteleyl.

$C_6H_4O_2 = C_6H_3O + HO$. Hydrated oxide of pteleyl, the aldehyd of the mesitic series.

$C_6H_3NO_4 = C_6H_3O + NO_3$. Hyponitrate of pteleyl.

The compound heavy liquid produced by the action of chlorine on mesitic alcohol, was found to differ but little from the description given by Liebig. Its formula, as given by Dr. Kane's analysis, is $C_6H_3O_2Cl_3$; and by the action of bases it yields a metallic chloride, and a salt of a new acid named by Professor Kane *Pteleic Acid.* This has not yet been analyzed, but theory indicates for its composition the formula $C_6H_3O_4$.

By the action of permanganate of potash on mesitic alcohol, there is generated a neutral salt of potash containing an acid, to which is given the nameof the *Perpteleic*, whose salts generally decompose themselves with facility into carbonates, and a salt of another acid to which the name of the *Acetonic Acid* has been applied. The constitution of these last three acids remains yet to be fixed by other experiments, the author confining himself in the present paper to the suggestion of that view of their composition, which, in the absence of positive analyses, seems to him most likely to be true.

Professor Kane exhibited to the Academy a balance made by a German artist, having some peculiarities of construction and adjustment.

It was resolved, "that the Council be authorized, if they deem it expedient, to purchase Mr. Underwood's collection of Irish antiquities."

DONATIONS.

Flora Batava, Nos. 105, 106. By H. C. Van Hall. Presented by the Author.

History of the Presbyterian Church in Ireland. By J. Seaton Reid, D. D. Vol. 1. Presented by the Author.

Le Primer Report des Cases et Matters en Ley resolus et adiudges en Ley Courts del Roy en Ireland. Presented by the same.

Transactions of the Royal Society of Edinburgh, Vol. 13, Part II. Presented by the Society.

Memoirs of the Royal Astronomical Society, Vols. 8 and 9. Presented by the Society.

Philosophical Transactions of the Royal Society of London, 1836, Part II. Presented by the Society.

List of the Fellows of the Royal Society, 30th November, 1836. Presented by the same.

Address delivered at the Anniversary Meeting of the Royal Society, on Wednesday, November 30th, 1836, by His Royal Highness the Duke of Sussex, K. G., &c. &c. &c. the President. Presented by the same.

Supplement to the Account of the Rev. John Flamstead, First Astronomer Royal. By Francis Baily, Esq., F. R. S., &c. &c. &c. Presented by the Author.

General Charte dir Geographischen Verbreitung und des Ganges der Cholera, 1816—1837. By Emel Isensee. Presented by the Author.

Neues System zur Ubersicht der inneren Krankheiten des Menschen. By the same.

Transactions of the Cambridge Philosophical Society, Vol. 6, Part I. Presented by the Society.

A Catalogue of the Collection of British Quadrupeds and Birds, in the Museum of the Cambridge Philosophical Society. Presented by the Society.

Discussion of the Magnetical Observations made by Captain Back, R. N., during his late Arctic Expedition. By Samuel Hunter Christie, M. A., F. R. S., &c. Presented by the Author.

April 24.

Rev. B. LLOYD, D. D., Provost T. C. D., President, in the Chair.

Charles Graves, Esq., F. T. C. D., and Thomas Wise, Esq., M. P., were elected members of the Academy.

A paper was read by Professor Kane "On *Dumasine*, a new Fluid Substance isomeric with Camphor."

This fluid is obtained in very small quantity in the distillation of acetate of lime for preparing mesitic alcohol. It boils at 248°, is colourless, and of a powerful resinous smell. Its composition by analysis is $C_{10}H_8O$. Thus:

$$\begin{array}{lll} & \text{Experiments.} & \text{Theory.} \\ \text{Carbon,} & = 78{,}82 & — 79{,}30 \\ \text{Hydrogen,} & = 10{,}46 & — 10{,}35 \\ \text{Oxygen,} & = 10{,}72 & — 10{,}35 \end{array} \left.\vphantom{\begin{array}{l}a\\a\\a\end{array}}\right\} 100{,}00$$

The specific gravity of the vapour of this liquid was found to be 5,204, air being 1. The theoretical density from the formula above given, is 5,315, and one atom forms

two volumes of vapour. It has, therefore, the same density as camphor, and like it may be considered as consisting of

1 volume of vapour of oil of turpentine,	= 4,7643
½ volume of vapour of oxygen,	= 0,5513
1 volume of vapour of dumasine,	= 5,3156

Professor Kane read some passages of a letter from M. Dumas, of which the following is an extract:

" * * * * The researches, of which you have given me an account,* promise the happiest results for science, I cannot too much encourage you to complete them; you will see by the journals that I have communicated your letter to the Academy of Sciences, where it met with the most honourable reception. Allow me to add, that M. Peligot and myself had obtained the carbo-hydrogen, $C_6 H_4$, as well by sulphuric acid as by anhydrous phosphoric acid. We had found, that potassium gave the product $C_6 H_5 O$, which you have obtained in another manner, but we were stopped by the composition of the sulpho-mesitylate of baryta, of which you have given the explanation. These researches have been made some time, but other matters caused us to neglect them, and I do not now regret it, since they are in such good hands. * * * * "

" * * * * I announced yesterday to the Academy the existence of the *carbo-vinate of potash*, which is

$$KO\,CO_2 + C_4 H_5 O + CO_2.$$

I also obtained, conjointly with M. Peligot, the *carbo-methylate of baryta*, which is

$$Ba.\,O\,CO_2 + C_2 H_3 O + CO^2.$$

In these bodies the acid changes very readily into carbonic

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* On pyroacetic spirit. See Proceedings, pp. 42 and 58.

acid and alcohol, or pyroxylic spirit; and it is remarkable, that to form them it is sufficient to pass carbonic acid into a solution of baryta in spirit of wood, or of potash in ordinary alcohol. I do not doubt but that similar bodies can be obtained with pyroacetic spirit, but I shall leave to you the pleasure of isolating them. * * * * "

" * * * * I shall communicate next Monday to the Academy, some observations which may interest you more than any other person;* I mean on compounds very analogous to double chlorides, and which I have obtained by means of urea and the alcaline chlorides. Such bodies appear to me decisive on the theory of the amides. * * * * "

Sir William Betham read a paper "On the Affinity of the Phœnician and Celtic Languages, and on the Cabiri and their Mysteries."

According to Sanconiathon, men in the third generation from Protogonus began to worship the sun under the name of *Baal Samen.* The Irish, and all the other Celtæ, worshipped the sun under the very same title of beal ꞅaṁaıɲ, the *Lord of Heaven;* and the æstuary of the Mersey is named *Æstuarium Belasamena* by Ptolemy.

It is probable, as asserted by many writers, that the patriarch Noah was deified under the names Deucalion, Ogyges, Saturn, Janus, &c. &c., for all these names are, in the Celto-Phœnician, appositely significant of the attributes of the supreme God: *Deucalion* signifies *the circle of life,* or the sun's course; *Ogyges, the supreme wisdom; Saturn, the Lord;* and *Janus, the ruler of ages.*

Sydyk, the 11th from Protogonus, according to Sanconiathon, is supposed to have been the patriarch Shem. He is said to have been the father of the seven Cabiri. These

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* For Dr. Kane's researches on the double chlorides and amides of mercury, see Transactions of the Royal Irish Academy, vol. xvii. p. 423.

children were probably the seven sciences personified and deified. Thus *Uranus* was astronomy; *Neptune*, navigation; *Pluto*, mining; *Jupiter Arotrius*, (*Ceres* or *Cybele*,) agriculture; *Mercury*, commerce or trade; *Vulcan*, mechanics or metallurgy; *Apollo*, music and the fine arts; to which was added *Æsculapius*, the inventor of medicine. It is remarkable that Chrysor, or Vulcan, stands in the same generation from Protogonus as Tubal Cain does from Adam.

The Cabiri were the *inventors of navigation*, and their connexion with mining led to the supposition that they were infernal deities. Phornutus has preserved a curious list of the titles of Pluto, which he vainly attempted to resolve in his own language, but which have all reference to mining and metals in the Phœnician.

The Pelasgi are said by Herodotus to have occupied Samothrace, and to have established the Cabiric mysteries, which they afterwards, under the name of Tyrrheni, carried into Italy. Accordingly we find the whole of Etruria replete with names of Pelasgic or Phœnician origin, thus:

Tyrsenus—The old land—tír seanaois.

Tarchon—The head land—tír cean, or *Cantyre*.

Attis—Rebuke, repulse—atais.

Telephus—The land of death, or malaria—tollaṁ-aise.

Auga—A bottom or flat valley.

Perusia—The city on the gentle slope of a river—bior uas ia.

Ciris—The swift stream—cirḃ uisge.

Italy—The corn country—iṫ·tallaṁ.

Argessa—The country of skilful tillage—ar gaosa.

Ausonia—The noble old country—aos on ia.

Tyrsenia—The land of old age—tír seanaois.

The island of Crete was one of the chief seats of the Cabiri, where they bore the names of Curetes, Idæi Dactyli, and Telchines. Nonnus says they were the sons of Neptune; and Diodorus that they were allied to the ocean; that they

first inhabited Rhodes, and were the children of the sea; that Neptune was committed to their care when an infant; and that they brought him up. In other words, the Phœnician Cabiri, or Mariners, *cultivated the science of navigation.*

Minos, the king of Crete, became enamoured of *Britomartis*, or *Dictynna*, and demanded seven youths and seven virgins annually, from the Athenians, *to be devoured by the Minotaur*;—in plain language to *work in the mines.* The name of Minos may be from mjanaċ *a miner*, or mjon *just*, aoṙ *sage.* The *Minotaur* was from mjana, *mines*, tojṙ, *pursuit, search.* The *devouring* by the monster is thus appositely explained. *Britomartis* signifies *Judgments of life*, bṙeata maṙt aoṙ. *Dictynna—Hot, fierce fires*, dajƺ tejna.

The Greeks invented the story of Britomartis hiding herself in fishermen's nets, in order to account, by a word of a similar sound in their own language, for the name *Dictynna.* This lady is said to have been born in Phœnicia, i. e. the *smelting ore by the blast or bellows was invented there;* and Minos was anxious to avail himself of this invention to change his ore into metal, which satisfactorily accounts for this fable.

This personage was also called *Laphria*, for Minos is said to have employed her to pronounce his judgments. This is labṙaḋ, *speech-making, giving sentence.* This fact also accounts for the name of Britomartis, *the judgments of life.*

The initiated of the Cabiri were *enjoined to the strictest secrecy respecting the names of the great Gods.* The reason of this is now obvious. Had they been known, the sources of the wealth of the Phœnicians would have been revealed.

Sir William Betham then added a short notice of a Hindoo Legend, from a paper in the Asiatic Researches, by Captain Wilford, showing that the Cabiric mysteries existed in India, under the names *Cubera* or *Cuvera*, *Asyoruca*, *Asyotcersa*, *Asyotchrista*, *Cashmala* and *Carmala;* and that these deities or genii superintended mining and metals.

Professor Mac Cullagh read a paper "On the Chronology of Egypt."

In this paper the author endeavours to ascertain the names of the Egyptian sovereigns who were contemporary with Moses. For this purpose he finds it necessary to determine the interval between two celebrated epochs—the reign of Menes and the Exodus of the Israelites. He conceives that the former epoch is fixed by the "old chronicle," at the distance of 443 years from the beginning of a cynic (or canicular) cycle; and he thinks it strange, that this simple meaning should not have occurred to chronologists, who have universally supposed the "cynic cycle" of the old chronicle to be a series of demi-god kings who derived that appellation from the dog-headed Anubis. The canicular cycle is a well-known period of 1460 years, which the Egyptians seem to have used for computing time, as we sometimes use the Julian period. One of these cycles commenced in the year 2782, before the Christian era; and if we reckon 443 years in advance, we shall have the year B. C. 2339, for the commencement of the reign of Menes. This date agrees well with the computation of Josephus, who says that the interval from Menes to Solomon was upwards of 1300 years. Again, we are told by Clemens of Alexandria, that the Exodus of the Israelites took place 345 years before the beginning of a canicular cycle. This is evidently the cycle which commenced B. C. 1322; and hence we have B. C 1667 for the date of the Exodus. The interval between Menes and the Exodus was, therefore, about 670 years.

If, now, we take the catalogue of Eratosthenes, which commences with Menes, we shall find, at the distance of 670 years from Menes, a king named Achescus Ocaras, who reigned only one year; preceded by a king named Apappus who reigned a hundred years, and succeeded by queen Nitocris who reigned six years. Mr. Mac Cullagh thinks, that Apappus is the king in whose reign Moses was born; that Ocaras is he who pursued the Israelites to the Red Sea

and that Nitocris is the famous queen mentioned by Herodotus. It may be objected, that Eratosthenes gives us the succession of Theban kings, whereas the Pharaohs of the Mosaic history reigned in Lower Egypt; but it is remarkable, that the three sovereigns mentioned above are found in Manetho's dynasties among those who reigned at Memphis; and it is singular, that these are the only sovereigns (except Menes and his immediate successor) in which the dynasties of Manetho and the catalogue of Eratosthenes agree. All the other names are different. Of course, the predecessors of Apappus, at Thebes and at Memphis, were different; and, thus, we can easily understand how there arose up at Memphis "a new king who knew not Joseph." It would appear, in fact, that Apappus was of a Theban family, and that he succeeded, for some reason or another, to the throne of Lower Egypt. He was only six years old (as we learn from Manetho) when he came to the throne; and it is natural to suppose, that his chief advisers, as he grew up, were the courtiers who accompanied the young king from his own country to Memphis, and who knew nothing of Joseph, and cared nothing for his people. Accordingly, when Apappus arrived at manhood, he issued an order, that every male child of the Hebrews should be destroyed, lest they should grow too numerous for the Egyptians; and, under these circumstances, Moses was born in the twenty-first year of his reign, and was saved by the king's young daughter, a girl about ten years' old. About the sixtieth year of Apappus, Moses was obliged to fly to the land of Midian, for having killed an Egyptian; and when, at length, the king of Egypt died—"after many days," as it is in the original—Moses returned in the beginning of the reign of Ocaras, before whom were performed those signs and wonders which prepared the way for the departure of the Israelites. On the night of the Passover, the king lost his first-born, perhaps his only son; and this may be

the reason that he was succeeded by his sister Nitocris. The short reign of Ocaras (a single year) might be explained by supposing that he was drowned in the Red Sea; but as there is nothing in the sacred narrative which obliges us to admit that the king perished in this manner, we may adopt the account of Herodotus, that he was murdered by his subjects. We may imagine that some of his nobles remained with Pharaoh on the shore; and that when they saw the sea return and swallow up all that had gone in after the Israelites, they murdered the king, whose obstinacy had brought such calamities on his people, and then placed his sister Nitocris on the throne. As Nitocris was the daughter of Apappus, there is nothing to prevent us from supposing that the queen, now ninety years old, was the princess who had saved the infant Moses. Weary of her life, she lived only to avenge her brother. For this purpose, says Herodotus, she constructed a large subterranean chamber, to which, when it was finished, she invited the principal agents in her brother's death; and there, by the waters of the Nile admitted through a secret canal, they were drowned in the midst of the banquet. The queen then threw herself into a room filled with ashes, where she perished.

Mr. Petrie, by permission of Colonel Colby, read the first part of a paper "On the Antiquities of Tara Hill," being a portion of the memoir written to illustrate the Ordnance Map of Meath, now on the eve of publication.

The author first gives a detail of the mode of investigation adopted. An accurate survey and ground plan of the locality was first procured. Translations were then made by Mr. O'Donovan of such ancient Irish MSS. as could be found relating to the subject of inquiry; the different copies, where such existed, having been carefully compared so as to obtain the greatest possible accuracy in the text. Those of chief value, two poems and a prose tract, are compositions

of the tenth, eleventh, and twelfth centuries, and are contained in the ancient Irish topographical work called the Dinseanchus, copies of which are preserved in the books of Lecan and Ballymote, in the possession of the Academy, as also in MSS. in the College Library, and in the library of the Duke of Buckingham at Stowe. Of the poems, one is the composition of Cinaeth O'Hartigan, who was chief historian of the northern half of Ireland, and according to the annals of Tighernach, died in 975. The other is the work of Cuan O'Lochain, who, according to the same authority, was killed in 1024, having been for the two previous years, chief poet and lawgiver of Ireland, after the dismemberment of the monarchy in the person of Maelseachlin the Second. The prose tract is not of equal antiquity with either of these pieces, but is more copious in its descriptive details, and is of a date at least prior to the twelfth century. The writer appears to have personally examined the monuments remaining in his time, and often describes their state of preservation with remarkable exactness.

From a comparison of the accounts given in these documents with the monuments ascertained by the survey to be still in existence, not only all the remaining vestiges have been identified with sufficient certainty to warrant the insertion of their respective names on the map, but the localities also of several other monuments of less importance, but which are now wholly effaced, have been so far determined as to furnish full materials for the construction of a ground plan, exhibiting a restoration of the whole.

The number of these monuments, and the great extent of ground which they cover, will be at once evident from an inspection of the map; and, as a striking instance of the historic interest possessed by them, it may be shortly stated, that the strongest evidence has been adduced, from MSS. much more ancient than any hitherto cited on the subject, to show that a remarkable obeliscal pillar-stone, which now

serves as a head-stone to the grave of the rebels who fell here in 1798, is the so celebrated *Lia Fail*, or coronation stone of the Irish kings, which has been generally supposed to have been carried into Scotland by the Dalriadic Colony in 503, and thence to have been taken by Edward the First into England, where a stone alleged to be the same is, it is well known, still shown under the coronation chair in Westminster Abbey.

This paper proves, in a very striking manner, the value and importance of the great national work to which it belongs; as, previously to the Survey, no accurate plan or description of the remarkable ruins of this remotely ancient seat of the Irish monarchs had ever been attempted, nor any critical examination instituted with a view to the elucidation of those Irish MS. records which bear upon the subject.

DONATIONS.

Essai Historique sur la Vie et la Doctrine d'Ammonius Saccas, chef d'une des plus célébres Ecoles Philosophiques d'Alexandrie. Par L. J. Dehant. Presented by the Royal Academy of Brussels.

Memoire sur les propriétes et l'Analyse de la Phloridzine. Par L. de Koninck. Presented by the Royal Academy of Brussels.

Bulletin de l'Academie Royale des Sciences et Belles-lettres de Bruxelles, for the year 1836. (Nos. 1 to 12.) Presented by the same.

Annuaire de l'Academie Royale des Sciences et Belles-lettres de Bruxelles. (Troisième Année.) Presented by the same.

Sur la Latitude de l'Observatoire de Bruxelles, par A. Quetelet. Presented by the Author.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1837. No. 5.

May 8.

REV. F. SADLEIR, D. D., F. T. C. D., Vice-President, in the Chair.

REV. Thomas M'Neece, F. T. C. D., was elected member of the Academy.

Mr. Petrie read the continuation of his paper "On the Antiquities of Tara Hill."

Professor Lloyd read the following extract of a letter from Mr. Bache, President of Girard College, Philadelphia, relating to a comparison of the Magnetic Intensity in Philadelphia, Dublin, and Edinburgh:

"I availed myself of an opportunity afforded by Professor Forbes, to observe the horizontal magnetic intensity at Edinburgh, in a locality as far from the disturbing action of the trap rocks, on the north of the town, as was convenient. The place (Canaan Park) adjoins that in which Mr. Dunlop's observations were made. After correcting for rate of chronometer and temperature of needle, &c. I get for Edinburgh (Dublin being unity) 0.9592. The dip, as determined by observation of Professor Forbes, (and given in a recent paper on the diminution of magnetic intensity at different heights,) is 71° 47′. I applied a small correction for the diminished

magnetic force of the needles, as deduced from observations of the previous year; this may not be precise, and may slightly change the number. The two needles gave respectively:

Bar.	Cylinder.	Diff.
.9576	.9607	.0031

"Taking your result for Dublin and London, and Captain Sabine's for London and Paris, I deduce for the ratio of Edinburgh and Paris, (the latter being unity) 0.8406,—which is nearly identical with the direct comparison made by Professor Forbes. It disagrees very materially with the result of Captain Hall, by whom Edinburgh and London were first compared; but as the locality of his observations was shown by Mr. Dunlop to have rendered them inaccurate, they cannot be said to make against these determinations. I have not yet had an opportunity to see how far Mr. Dunlop's correction would make the three sets coincide.

"My determinations give:

Philadelphia, . . .	1.0000
Dublin, ...	0.8300
Edinburgh, ...	0.7957

But, of course, the correction for the loss of magnetism by the needle, if not exact, would affect these results more than that for the two last named places."

DONATIONS.

Flora Batava, No. 109. By H. C. Van Hall. Presented by the Author.

A Copy of the Ordnance Survey of the County of Meath, in 55 sheets. Presented by Lieutenant-Colonel Colby.

On the Arenarius of Archimedes. By Stephen Peter Rigaud, M.A., Savilian Professor of Astronomy, Oxford. Presented by the Author.

Mean Heights of the Barometer and Thermometer, with the Fall of Rain, at the Observatory, Oxford, during each month of the years 1828 *to* 1836. Presented by the same.

May 22.

REV. B. LLOYD, D. D., Provost, T. C. D., President, in the Chair.

REV. James Horner, D. D., was elected member of the Academy.

Professor Mac Cullagh read a letter from Joseph S. Moore, Esq. on the Australian instrument called *kilee* or *boomerang*, so remarkable for the course that it takes when thrown in the air. It is a flat piece of wood of a hyperbolic form, about 2½ inches broad, perfectly plane on one side, and slightly convex on the other. A right line joining its extremities is about two feet long, and the middle of this right line is distant about a foot from the middle of the instrument or the vertex of the hyperbola. When properly thrown, it makes a circuit, returns, passes close to the person who threw it, and even goes behind him, and then attempts to return again before it falls to the ground. It is curious that such a missile should have been invented by savages, for, as far as we know, it is found only among the natives of New Holland. It is said to be called *kilee* on the western, and *boomerang* on the eastern coast of that country. Some of these *kilees* had been sent to Mr. Moore from the Swan River, and though he was unsuccessful in throwing them, he succeeded with others which he caused to be made of the same general form, but much more curved than the originals. The dimensions given above are those which he found most convenient. The following is an extract from Mr. Moore's letter:

"The natives throw them with the convex edge against the air; their movement is then from left to right. But the way in which I have succeeded was by taking the missile by

one end, with the concave edge inward, and the plane side undermost, the plane making an angle of about forty degrees with the horizon; throwing as if to strike the ground at the distance of about thirty yards, and giving it, on leaving the hand, a rapid rotatory as well as progressive motion. Instead of striking the ground at which it was aimed, its plane becomes horizontal at the distance of twenty-five yards, and so continues for about fifteen yards, when it commences rising in the air, and moving towards the left; its plane then becomes inclined, and continues at an angle of from thirty to forty degrees, whilst it describes apparently a segment of a circle to the left. Having, at the distance of sixty or seventy yards, attained an altitude of from forty to sixty feet, the projectile returns, descending to the point from which it was projected, when its plane becoming once more horizontal, i skims along within a few feet of the ground, and passes close by the right hand of the person who threw it. On passing its plane becomes elevated once more, it rises a second time and performs another smaller curve, (fifteen or twenty yard behind the projector,) in like manner as the first, with thi singular exception, that the second curve is described fron left to right, contrary to the course of its rotation and of th first curve, which is invariably from right to left."

In bringing the instrument under the notice of the Aca demy, Mr. Mac Cullagh wished to draw attention to th theory of its motion. When a body of any form whatsoeve is projected in vacuo, we know that its centre of gravit must describe a parabola in a vertical plane, while the bod spins about an axis passing through that centre. In the pre sent case, therefore, it is clear that the continued swerving fro the vertical plane must be ascribed to the action of the ai But to compute accurately the mutual action of the air, an of a body endued, at the same time, with a progressive an a rotatory motion, is a problem far beyond the present power of science. The problem can only be solved approximately

and, however we may simplify it, the calculations are likely to be very troublesome. Even the supposition of a resistance proportional to the square of the velocity (which is usually considered as an approximation in questions of this sort), would lead to complicated results. It may be observed, that the motion of the *kilee* is rudely imitated in the familiar experiment with a card, cut into the form of a crescent, and sent off by a fillip, so as to spin in its own plane.

Mr. Petrie read the concluding portion of his paper "On the Antiquities of Tara Hill."

In this, as well as in the preceding part, the author has endeavoured to ascertain from historic evidences, not only the period to which each of the monuments now remaining should be referred, but also the date of those of which no vestiges exist, but whose features and localities are described in ancient documents. In this investigation, the author brought forward a great number of ancient Irish authorities not hitherto used or translated, of which one of the most curious and interesting is a description of the banqueting hall or house of assembly, written by Cinaeth O'Hartigan, a celebrated poet of the tenth century. From all these documents it appears, that, with the exception of the original Túatha Dedanann cahir, and coronation stone, all the monuments now or formerly existing on Tara Hill may be classed under two distinct eras, both within the limit of authentic Irish history. The first and less important class comprises the monuments belonging to the age of the hero Cuchullin, who died in the early part of the first century; and of these there are no remains. The second—to which nearly all the existing monuments belong—extends to the time of the monarch Cormac Mac Art, in the third century. There are only two or three monuments of later date. From these facts, the author concludes, that, before the latter period, Tara had attained to

no distinguished celebrity as a regal city; and hence its omission from the map of Ptolemy, who wrote in the century preceding.

Another fact, derived both from historic evidences and existing remains, is, that, with the exception of the cahir erected by the Tuatha Dedananns, all the works appear to have been of earth and wood; though forts and houses of uncemented stones are found in other districts of equally ancient or even earlier date. From the uniform character which pervades these remains, the author concludes that they are the monuments of *one* people; and he thinks that the fact above mentioned may help to elucidate the origin of that Scotic race, which ruled in Ireland at the period of their construction.

Sir William Hamilton laid before the Academy an account of some investigations, in which he had recently been engaged, respecting Equations of the Fifth Degree. They related chiefly to three points: first, the argument of Abel against the possibility of generally and algebraically resolving such equations; second, the researches of Mr. Jerrard; and third, the conceivable reduction, in a new way, of the original problem to a more simple form.

1. The argument of Abel consisted of two principal parts; one independent of the degree of the equation, and the other dependent on that degree. The general principle was first laid down, by him, that whatever may be the degree n of any general algebraic equation, if it be possible to express a root of that equation, in terms of the coefficients, by any finite combination of rational functions, and of radicals with prime exponents, then every radical in such an expression, when reduced to its most simple form, must be equal to a rational (though not a symmetric) function of the n roots of the original equation; and must, when considered as such a function, have exactly as many values, arising from the

permutation of those n roots among themselves, as it has values, when considered as a radical, arising from the introduction of factors which are roots of unity. And in proceeding to apply this general principle to equations of the fifth degree, the same illustrious mathematician employed certain properties of functions of five variables, which may be condensed into the two following theorems: that, if a rational function of five independent variables have a prime power symmetric, without being symmetric itself, it must be the square root of the product of the ten squares of differences of the five variables, or at least that square root multiplied by some symmetric function; and that, if a rational function of the same variables have, itself, more than two values, its square, its cube, and its fifth power have, each, more than two values also. Sir W. H. conceived that the reflections into which he had been led, were adapted to remove some obscurities and doubts which might remain upon the mind of a reader of Abel's argument; he hoped also that he had thrown light upon this argument in a new way, by employing its premisses to deduce, *à priori*, the known solutions of quadratic, cubic, and biquadratic equations, and to show that no new solutions of such equations, with radicals essentially different from those at present used, remain to be discovered: but whether or no he had himself been useful in this way, he considered Abel's result as established: namely, that it is impossible to express a root of the general equation of the fifth degree, in terms of the coefficients of that equation, by any finite combination of radicals and rational functions.

2. What appeared to him the fallacy in Mr. Jerrard's very ingenious attempt to accomplish this impossible object, had been already laid before the British Association at Bristol, and was to appear in the forthcoming volume of the reports of that Association. Meanwhile, Sir William Hamilton was anxious to state to the Academy his full conviction, founded

both on theoretical reasoning and on actual experiment, that Mr. Jerrard's method was adequate to achieve an almost equally curious and unexpected transformation, namely, the reduction of the general equation of the fifth degree, with five coefficients, real or imaginary, to a trinomial form; and therefore ultimately to that very simple state, in which the sum of an unknown number, (real or imaginary), and of its own fifth power, is equalled to a known (real or imaginary) number. In this manner, the general dependence of the modulus and amplitude of a root of the *general* equation of the fifth degree, on the five moduli and five amplitudes of the five coefficients of that equation, is reduced to the dependence of the modulus and amplitude of a new (real or imaginary) number on the one modulus and one amplitude of the sum of that number and its own fifth power; a reduction which Sir William Hamilton regards as very remarkable in theory, and as not unimportant in practice, since it reduces the solution of any proposed numerical equation of the fifth degree, even with imaginary coefficients, to the employment, without tentation, of the known logarithmic tables, and of two new tables of double entry, which he has had the curiosity to construct and to apply.

3. It appears possible enough, that this transformation, deduced from Mr. Jerrard's principles, conducts to the simplest of all forms under which the general equation of the fifth degree can be put; yet, Sir William Hamilton thinks, that algebraists ought not absolutely to despair of discovering some new transformation, which shall conduct to a method of solution more analogous to the known ways of resolving equations of lower degrees, though not, like them, dependent entirely upon radicals. He inquires in what sense it is true, that the general equation of the fifth degree would be resolved, if, contrary to the theory of Abel, it were possible to discover, as Mr. Jerrard and others have sought to do, a reduction of that general equation to the

binomial form, or to the extraction of a fifth root of an expression in general imaginary? And he conceives, that the propriety of considering such extraction as an admitted instrument of calculation in elementary algebra, is ultimately founded on this: that the two real equations,

$$x^5 - 10x^3y^2 + 5xy^4 = a,$$
$$5x^4y - 10x^2y^3 + y^5 = b,$$

into which the imaginary equation

$$(x + \sqrt{-1}\,y)^5 = a + \sqrt{-1}\,b$$

resolves itself, may be transformed into two others which are of the forms

$$\rho^5 = r, \text{ and } \qquad \frac{5\tau - 10\tau^3 + \tau^5}{1 - 10\tau^2 + 5\tau^4} = t,$$

so that each of these two new equations expresses one given real number as a known rational function of one sought real number. But, notwithstanding the interest which attaches to these two particular forms of rational functions, and generally to the analogous forms which present themselves in separating the real and imaginary parts of a radical of the n^{th} degree; Sir William Hamilton does not conceive that they both possess so eminent a prerogative of simplicity as to entitle the inverses of them alone to be admitted among the instruments of elementary algebra, to the exclusion of the inverses of all other real and rational functions of single real variables. And he thinks, that since Mr. Jerrard has succeeded in reducing the general equation of the fifth degree, with five imaginary coefficients, to the trinomial form above described, which resolves itself into the two real equations following,

$$x^5 - 10x^3y^2 + 5xy^4 + x = a,$$
$$5x^4y - 10x^2y^3 + y^5 + y = b,$$

it ought now to be the object of those who interest themselves in the improvement of this part of algebra, to inquire,

whether the dependence of the two real numbers x and y, in these two last equations, on the two real numbers a and b, cannot be expressed by the help of the real inverses of some new real and rational or even transcendental functions of single real variables; or, (to express the same thing in a practical, or in a geometrical form,) to inquire whether the two sought real numbers cannot be calculated by a finite number of tables of single entry, or constructed by the help of a finite number of curves: although the argument of Abel excludes all hope that this can be accomplished, if we confine ourselves to those particular forms of rational functions which are connected with the extraction of radicals.

DONATIONS.

Voices from the Time of the Reformation of the Danish Church. (In Danish.) Presented by the Literary Society of the Diocese of Funen.

Observations on some of the Strata between the Chalk and Oxford Oolite, in the South-East of England. By William Henry Fitton, M.D., F.R.S., &c. Presented by the Author.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1837. No. 6.

June 12.

REV. B. LLOYD, D.D., Provost, T.C.D., President, in the Chair.

A PAPER was read, entitled, "An Inquiry into the Possibility of transplanting the Cornea, with the view of relieving Blindness occasioned by Diseases of that Structure." By Samuel Lenox Bigger, Esq.

The author stated that his expectation of succeeding in this operation had been first raised by the partial success attending an attempt which he had made, while a prisoner with a nomadic tribe of Arabs,—the subject of the operation being a gazelle. Having been thus led to inquire what had been done elsewhere to relieve or cure the opaque state of the cornea, Mr. Bigger found that the idea of performing the operation of transplantation had been entertained in Germany alone; that experiments had been made in that country, by Moesner, Reisinger, Schön, Drolshagen, Dieffenbach, and Thomé, with various results; but that Wutzer was the only person whose belief in the possibility of the operation led him to attempt it on the human subject,—an attempt in which he was unsuccessful, owing to the resistance of his patient.

The author then described the plan of operation which

he had found most successful, and which had been hitherto untried. The results of several experiments performed according to this plan were then read. In a series of eighteen experiments, the iris was injured in ten; the crystalline lens escaped in eleven; union took place between the implanted portion and the adjacent parts in seventeen, in the space of forty-eight hours; in twelve, adhesion of the iris took place to some part of the cicatrix; sixteen were restored to imperfect vision; and in one, slough of the lambeau, and consequent destruction of the eye, occurred, the portion of cornea to be inserted having been detained half an hour before it was attached, in order to try how long it would retain vitality sufficient to enable it again to take on a vital action.

The author made several experiments with iodine, nitrate of silver, &c., and found that they were incapable of producing any effect on the milky state of the cornea, although they appeared to diminish the extent of the cicatrix; corrosive sublimate (in the proportion of from half a grain to three grains to the ounce of water) was the only medicinal substance tried which had the power of restoring absolute clearness to the implanted portion.

The author then mentioned the various means he had employed to produce absorption of the cicatrix, with their results; explained his view of the cases in which this operation might be attempted; and concluded by entreating those surgeons, who possessed hospitals, not to be too hasty in rejecting an operation, which, from the experiments detailed, and the living subjects exhibited, was now proved to be at least possible.

Mr. Bigger then made an oral communication on a series of experiments in which he was at present engaged, connected with the operations detailed in his paper. The object of these experiments was the removal of small spots of opaque lymph, where they existed in the centre of the cornea. The method employed consisted in passing a liga-

ture through the opaque spot with a curved needle, which serves to fix the eye. Another needle is then passed at right angles to the former, and armed with a very fine ligature, which is allowed to remain loose. The first ligature being then strained, an incision is made equal in length to the nebulous portion; then raising it by the ligature, the whole opaque portion may be removed with a sharp curved scissors, and by drawing the ligature of reserve, the two fresh incised surfaces brought together.

Professor Kane read a paper "on the Composition of certain essential Oils."

The first object of the author, in commencing the examination of this subject, was to collect facts towards an approximate solution of the problem, "*whether there can be found any law connecting the composition of the secretions of plants of the same genus or natural family.*" The three alcaloids of the genus cinchona, giving the formulæ

$$R + O, R + 2O, R + 3O,$$

appear to furnish a glaring instance of the existence of such a law; but the want of connexion in the composition of the constituents of opium might be advanced in opposition, although not quite a parallel case. The family of the coniferæ appear well characterized by the presence of the hydrocarbon C_5H_4 and its oxides; but the same composition is found prevailing among the aurantiæ, as in oil of lemons, —the myrti, as in the neutral oil of cloves,—and the lauri, as in common camphor; whilst other members of the same family, as oil of cinnamon, have formulæ altogether different.

The members of the family of the labiatæ are characterized by yielding remarkably aromatic oils by distillation; and as many of these oils, from their use in medicine, are

easily procured in commerce, Professor Kane considered that the determination of the composition of the products of certain members of a botanical group, whose natural connexion is among the best marked, might tend to throw some light upon the question at issue. He, therefore, examined the oils of the origanum vulgare, lavandula spica, mentha piperita, mentha puleghium, and mentha sativa. Great difficulty was found in obtaining the specimens so absolutely pure as to fit them for analysis, as all such oils contain small quantities of solid matters, (camphors of the essential oils, stearoptens,) which render impure the later products of the rectification.

Repeated analyses of the oil of the mentha puleghium, gave for its composition the same formula as for oil of turpentine, or oil of lemons, that is C_5H_4, or per cent.

	Theory.	Experiment.
Carbon	= 88,45	— 88,56
Hydrogen	= 11,55	— 11,87

Its boiling point is about 314° F., the same as that of turpentine.

The oil of mentha sativa, boiling at 320° F., gave, by several accordant analyses, the formula,

$C_{35}H_{28}O$ or $7\{C_5H_4\}+O$, and per cent.

	Theory.	Experiment.
Carbon	= 85,67	— 85,66
Hydrogen	= 11,15	— 11,38
Oxygen	= 3,18	— 2,96

The oil of the origanum vulgare, boiling at 324° F., gave as the result of five analyses, which varied very little from one another, the formula,

$C_{50}H_{40}O$ or $10\{C_5H_4\}+O$, and per cent.

	Theory.	Experiment.
Carbon	= 86,48 —	86,33
Hydrogen	= 11,27 —	11,44
Oxygen	= 2,25 —	2,23

These three oils, therefore, have the same hydrogen and carbon, and differ only in the two latter having absorbed small, but perfectly definite quantities of oxygen.

Oil of the lavendula spica, boiling at 365° F., gave as result, the formula $C_{12}H_{10}O$, or per cent.

	Theory.	Experiment.
Carbon	= 80,35 —	79,45
Hydrogen	= 10,90 —	11,30
Oxygen	= 8,75 —	9,25

The oil of peppermint had been analyzed by Blanchet and Sell, who obtained results, giving the formula $C_{12}H_{10}O$, which has been found above for oil of lavender. As their analyses were only two in number, and are given in the Journal de Pharmacie without any explanatory detail, Professor Kane thought it not superfluous to add to the above experiments a confirmation of their results. On purifying oil of peppermint of commerce, (having selected the foreign oil that it might be more probably what they had examined,) Professor Kane found that the more it was rectified and the earlier condensed the specimens analyzed were, the more the boiling point approached to 314°, and the composition to the formula C_5H_4. The difference between this result and that of Blanchet and Sell is too great to be explained by an error in the analyses of chemists whose other labours have shown such accuracy in quantitative research: Professor Kane accordingly thinks it not improbable, that there are two oils of peppermint of different compositions, and he is now occupied in seeking amongst the commercial samples for that with which the other chemists had been engaged.

Since the paper of which the preceding is an abstract was read, Professor Kane has examined the English oil of peppermint, which, when pure, has a density of 0,899, and boils at 365°. Its composition is

$$C_{25}H_{22}O_2 \text{ or } 5\{C_5H_4\}+H_2O_2 \text{ and per cent.}$$

	Experiment.		Theory.	
Carbon	= 80,14	—	80,15	
Hydrogen	= 11,76	—	11,48	100.
Oxygen	= 8,10	—	8,37	

This formula differs from Blanchet's in the hydrogen, which Blanchet's formula makes 10,9.

Oil of rosemary has been likewise examined, its density is 0,85, and it boils at 332°. It gave the formula,

$$C_{45}H_{38}O_2 = 9\{C_5H_4\}+H_2O_2 \text{ and per cent.}$$

	Experiment.		Theory.	
Carbon	= 83,49	—	83,73	
Hydrogen	= 11,66	—	11,51	100,00.
Oxygen	= 4,85	—	4,86	

The foreign oil of peppermint Professor Kane considers to be a mixture of nearly equal parts of genuine oil and of oil of turpentine; and hence the results obtained in its analysis as detailed above.

A paper "on Atmospheric Electricity" was then read by Edward S. Clarke, Esq.

The author having lately erected, at his residence near Palmerston, an apparatus adapted to observations on this subject, he exhibited to the Academy a drawing of the instrument. He stated, that in bringing the subject under the notice of the Academy, he had two objects in view,—the first, to compare the results of his experiments with those previously obtained by other observers; and the second, to induce others to erect similar instruments, feeling

assured that contemporaneous observations would throw much light upon the subject.

The more important results obtained by Mr. Clarke during the past two months are :

1st. That atmospheric electricity in serene weather is invariably positive.

2nd. That it is more intense during fogs, especially if they occur during frosty weather.

3rd. That in cloudy weather, (without rain,) the aerial electricity diminishes in intensity.

4th. That during heavy rain, hail, snow, or sleet, (and particularly at their commencement,) the atmospheric electricity is very intense. This electricity is, at first, invariably negative, but sometimes changes its state frequently during the storm.

5th. That the periods of its diurnal changes of intensity vary considerably, the intensity being at a maximum (during the past two months) each day some time between 7½, A. M., and 10½, A. M. ; becoming almost evanescent at noon; and ascending progressively for a few hours previous to sun-set. It acquires its nocturnal maximum some time between 9 and 12, P. M.; when it again declines gradually until some hours after sun-rise.

6th. That the nocturnal electricity, with or without dew, is stronger than the diurnal.

The foregoing observations are for the most part confirmed by those of Cavallo. But, the sixth observation does not agree with those of Canton, Abbè Mazeas, M. De Saussure, and Mr. Cross; the two former observers not having observed any electricity at night, and the two latter finding it weaker than by day. M. De Saussure conceived the electricity of the evening to be strong in consequence of the dew acting as a conductor, whilst the author has observed it very strong when there was no dew. M. De Saussure has likewise stated the maximum of diurnal electricity

to occur some hours after noon, it being also strong at noon; whilst Mr. Clarke usually found it almost evanescent at that period. These differences, the author conceives, may arise from difference of climate, or imperfect insulation of the instruments.

Mr. Clarke believes the electric intensity exhibited by the various clouds to be in the following order:

The nimbus, the cumulo-stratus, the cumulus, the stratus, the cirro-stratus, the cirro-cumulus, and the cirrus.

DONATIONS.

Asiatic Researches, Vol. XIX. Part 1. Presented by the Asiatic Society.

The London Medical and Surgical Journal, for April, 1837. Presented by the Editor.

June 26.

REV. B. LLOYD, D. D., Provost, T. C. D., President, in the Chair.

Matthew O'Conor, Esq., was elected member of the Academy.

Professor Liebig, of Giessen, was elected honorary member of the Academy.

A paper was read, "on a new Gaseous Compound of Carbon and Hydrogen." By Edmund Davy, Esq., F.R.S. &c., Professor of Chemistry in the Royal Dublin Society.

This compound was procured by the action of water on a black substance obtained by exposing a mixture of cream of tartar and charcoal powder to a strong heat in an iron bottle. The gas is highly inflammable, and when kindled in contact with air, it burns with a bright white flame, apparently denser and of greater splendour than even olefiant

gas. It forms with oxygen a powerfully explosive mixture, when the volume of the latter is to that of the former, as three or four to one. The new gas explodes spontaneously when brought in contact with chlorine gas; and this effect is accompanied with the production of flame, and the copious deposition of carbon: and is quite independent of the action of light, or the sun's rays, as it readily takes place in the dark. Under the ordinary pressure of the atmosphere, water absorbs about its own bulk of the gas, which is again liberated by heat, apparently unaltered.

According to Professor Davy's experiments, the new gas consists of a volume of hydrogen gas and two volumes of the vapour of carbon condensed into one volume; and it requires for its complete combustion two and a half volumes of oxygen gas. Its specific gravity is 0.917, that of common air being 1.000. 100 cubic inches of it weigh 28.4378 grains.

The equivalent of the new gas appears to be 13.24, and the formula by which it is expressed is $2\text{C}+\text{H}$, or C^2+H. The name proposed for it is *bicarburet of hydrogen*, which simply expresses its chemical constitution.

A paper by Professor Mac Cullagh, "on the Properties of Surfaces of the second Order," was read.

Among various other matters, this paper contains a new class of properties which are analogous to the focal properties of the conic sections. The author has found that surfaces of the second order may be generated by means of a given point as focus, a given right line as directrix, and a given plane. In general, every such surface is the locus of a point, whose distance from the focus bears a given ratio to its distance from the directrix, the latter distance being measured parallel to the given plane. This mode of generation, however, excludes surfaces of revolution about the major axis, as the corresponding generation of the conic sections excludes the circle. When the given ratio is not

one of equality, the surface has circular sections parallel to the given plane; when it is a ratio of equality, we get the hyperbolic paraboloid. All other things remaining the same, the focus and directrix may be changed without changing the surface described. If we confine ourselves to the central surfaces, the locus of the foci for a given surface will be an ellipse, which may be called the focal ellipse, each focus having a corresponding directrix perpendicular to the plane of this ellipse.

If the focal ellipse be made the base of a cone, whose vertex is at any point v on the surface, the normal at this point will be one of the principal axes of the cone. But, as three surfaces, confocal to each other, and therefore having the same focal ellipse, may be described through a given point, if we suppose two other such surfaces to pass through the point v, the normals to these surfaces will be the other two principal axes of the cone. And if a system of surfaces, confocal to these three, be circumscribed by cones having a common vertex at v, the principal axes of all these cones will be the same as those of the cone which has the focal ellipse for its base. Indeed, the focal ellipse (which lies in the plane of the greatest and the middle axes of the ellipsoids) may, in the confocal system, be considered as the limit between the ellipsoids and the hyperboloids of one sheet. There is also, in the plane of the greatest and least axes of the ellipsoids, a focal hyperbola which is the limit between the confocal hyperboloids of one and of two sheets; and of course, the cone which has this hyperbola for its base, and v for its vertex, has the same principal axes as the cones already mentioned. Right lines which pass, at the same time, through the focal ellipse and the focal hyperbola, possess remarkable properties.

The foregoing are the leading propositions in Mr. Mac Cullagh's paper. There are besides many particular theorems which could not be noticed within the compass of an abstract.

Mr. Graves, Fellow of Trinity College, mentioned the following theorem of his own, relative to confocal surfaces :—

"If there be two confocal surfaces of the second order, one of which is circumscribed by a cone whose plane of contact touches the other surface in a certain point, the normal at this point will pass through the vertex of the cone."

A new rain-gauge was exhibited to the Academy, contrived by the Rev. Thomas Knox.

The object of this instrument is to register the amount of rain that falls when the wind is in different points. Its construction is very simple. The water,—instead of descending from the reservoir directly into the tube of registry,—passes through a lateral tube into an annular-shaped vessel, divided into eight compartments, each of which terminates below in a graduated glass tube. It is obvious, then, that if the eight tubes be set to correspond with the cardinal and intermediate points, and that the reservoir be made to revolve on a vertical axis by means of a vane, the direction of which corresponds with that of the lateral tube, the object proposed will be attained. Mr. Knox has preferred to make the reservoir fixed, and the system of tubes moveable; but the result is obviously the same.

The Academy then proceeded to consider the amendments of the by-laws, proposed by the Council; and, after some discussion, it was resolved that there be an adjourned meeting at two o'clock, on Friday the 30th of June, for the further consideration of the subject.

DONATIONS.

A Copy of the Ordnance Survey of the County of Leitrim, in 40 sheets. Presented by Lieutenant-Colonel Colby.

Proceedings and Ordinances of the Privy Council of England, Vols. VI. and VII. Presented by the Commissioners of the Public Records.

The ancient Kalendars and Indentaries of the Treasury of his Majesty's Exchequer, 3 Vols. Presented by the same.

Excerpta è Rotulis Finium in Turri Londinensi asservatis, Henrico Tertio Rege, A. D. 1216—1272. Cura Caroli Roberts. Vol. II. A. D. 1246—1272. Presented by the same.

A Brief Description of the Etruscan and Greek Antiquities, now exhibited at No. 121, *Pall Mall.* Presented by Sir William Betham.

An Address to Astronomical Observers, relative to the Improvement and Extension of the Astronomical Society's Catalogue of 2881 *principal Stars.* Presented by Francis Baily, Esq.

On the Atmospheric Tides and Meteorology of Dukhun. By Lieutenant-Colonel W. H. Sykes, F.R.S., &c. &c. Presented by the Author.

The same Author presented also the following papers to the Academy:

On the Geology of a portion of Dukhun, East Indies.

On the Quails and Hemipodii of India.

On the Increase of Wealth and Expenditure in the various Classes of Society in the United Kingdom, as indicated by the Returns made to the Tax-office, Exports and Imports, Savings' Banks, &c. &c.

Description of the Wild Dog of the Western Ghâts.

Some Account of the Kolisurra Silk-worm of the Deccan.

Remarks on the Identity of the Personal Ornaments sculptured on some Figures in the Budd'ha Cave Temples at Carli, with those worn by the Brinjaris.

Land Tenures of Dukhun, Parts 1 and 2.

A Catalogue of the Mammalia and Birds observed in Dukhun, East Indies.

Abstract of the Statistics of Dukhun, (Deccan,) 1827-28.

Description of a new Species of Indian Ants.

Remarks on the Origin of the popular Belief in the Upas, or Poison Tree of Java.

June 30, (Adjourned Meeting.)

Rev. B. LLOYD, D.D., Provost, T.C.D., President, in the Chair.

The Academy resumed the consideration of the Amendments in the By-laws, proposed by the Council.

The following laws and amendments were agreed to at this and at the preceding meeting.

Chap. II. for section 3, substitute the following:

"No balloting for members shall take place except on the second Monday in the month. The names of the candidates, with the names of the proposer and seconders, shall be read out by the Secretaries immediately previous to the ballot."

In section 6, add, "the names of candidates proposed, with the names of the proposer and seconders, shall be read out by the secretaries on the evening of their proposal. The names to remain a month on the books."

In section 9, omit the words "or of the council;" and introduce the words, "in the face of the Academy," after the word "Charter-Book."

Chap. III. at end, introduce the words, "and shall have discharged all arrears due," after the word "Academy."

Chap. IV. section 3, the second in the order of Proceedings shall be "admission of new members;" and the eighth, "names of candidates proposed read."

Introduce, as section 4, the following by-laws:

"All papers shall be read in the order in which permission shall have been granted by the council,—with this exception: that if any paper be withheld during the entire evening, it shall not be read but in such order as the council shall determine."

"No new paper shall be commenced after 10 o'clock. The time to be occupied in the reading of any one paper

each night of meeting shall not exceed half an hour, except by a vote of the Academy; it being understood, that if a paper be not finished in one evening, it shall have precedence on the succeeding night."

Chap. V. section 2, to be altered as follows:

"There shall be two secretaries—of the Academy and of the council,—who shall attend all the meetings of the Academy and council, and to each of whom shall be paid a salary of twenty guineas per annum."

Section 3 repealed, and the following substituted:

"There shall also be a secretary of foreign correspondence."

Section 4 to be altered as follows:

"There shall also be a treasurer, (to whom a salary of twenty guineas per annum shall be paid,) who shall attend each night of meeting."

Section 5 to be altered as follows:

"A clerk and assistant librarian shall be elected annually, who shall not be a member of the Academy, and whose duty shall be, &c."

Chap. VI. section 5, repealed.

Chap. VII. section 1, to be altered as follows:

"The member who proposes any member for admission shall, previous to the ballot, deposit in the hands of the treasurer to the Academy the sum of five guineas, as admission fee of such person; said sum to be returned in case of rejection."

Section 2 to be altered as follows:

"Every member, besides his admission fee, shall pay the sum of two guineas annually, becoming due on the 16th of March next after the admission of such member,—except his election shall have taken place between the 1st of January and the 16th of March, in which case his first annual subscription will not become due until the 16th of March in the year following."

Section 4, the following words to be added:

"Any member may compound for future annual payments by paying the sum of twenty guineas at one payment; but any member," &c.

Chap. VIII.—Section 1 to be altered as follows:

"The key of the library shall be entrusted to no person but the librarian or assistant librarian, one of whom shall be always present during library hours.

Section 2, to be altered as follows:

"The library shall be open every day, Sundays excepted, throughout the year, (except during Christmas week, Passion week, and the month of August,) from eleven A. M., to four P. M."

Section 3 repealed.

Section 6 repealed.

Section 7 to be altered as follows:

"That members have the privilege of borrowing books from the library, with certain after-mentioned exceptions; and that the sub-librarian, before lending any book or books, must," &c.

The following sections to be added:

Section 9.—"No member who is in arrear shall on any account be allowed the use of the library; and for the better carrying such law into effect, the names of such defaulters shall be hung up in the library."

Section 10.—"That no manuscript be lent, without the special permission of the council. That the same rule be extended to rare and expensive works, (to be marked with an asterisk in the printed catalogue,) as also to dictionaries and encyclopædias."

Section 11.—"That the sub-librarian be desired to examine the state of the books lent, upon their delivery and return.

Chap. IX.—Sections 4, 6, 7, and 8, repealed.

Section 12, the commencement to be altered as follows:

" That medals be given each year for the best Essays in some proposed principal subject, or branch of science, polite literature, or antiquities, which shall be read, &c."

And at the end, the following clause to be added, " The council shall also have the power of awarding medals for the best Essays read during the year."

The following chapter to be added to the by-laws :—

" Of the Committee of Publication :

" 1. A committee shall be formed, corresponding to the committee of publication of the Royal Society.

" 2. The committee shall consist of seven members; three from the committee of science, and two from each of the other committees.

" 3. It shall be the duty of this committee—

" 1. To report to council on all papers offered for publication in the Transactions.

" 2. To superintend the final correction of the press, and to see that the printing and engraving are executed in a manner creditable to the Academy.

" 3. To arrange all details connected with the printing and publication of the Transactions and Proceedings of the Academy.

" 4. The committee shall have liberty to call in any member of the council or Academy to assist them in reading or judging of any paper."

The Academy then adjourned to the second Monday in November.

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY,

FOR THE YEAR 1837-8.

PART II.

DUBLIN:
PRINTED BY R. GRAISBERRY,
PRINTER TO THE ACADEMY.
M.DCCC.XXXVIII.

GEOLOGICAL
DUBLIN
SOCIETY.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1837. No. 7.

November 13.

REV. B. LLOYD, D. D., Provost, T. C. D., President, in the Chair.

ROBERT SHAW, Esq., Bushy Park, was elected an ordinary, and Captain W. H. Smith, an honorary member of the Academy.

Rev. Dr. Wall, Senior Fellow of Trinity College, read a paper on the "Original State of the Text of the Hebrew Bible, and on the Nature, Age, and Origin of the Sanscrit Writing and Language;" but he only touched upon the first subject as far as was necessary for the introduction of the second.

All the letters of the Hebrew text, in its original state, were employed as signs of syllables, beginning with consonants, and ending with vowels. The vowel part of every syllable being variable, it was left to the judgment of the reader to determine, for each place of the occurrence of a letter, the vowel which his knowledge of the language showed him was required by the context. Even still, near four-fifths of the vowels must, in reading the present unpointed text, be supplied in a similar manner; the only difference being, that they are no longer considered to be included in what the letters express, the powers of those

letters having been decomposed, in consequence of which they are now used as consonants. The remaining portion of the text at present, indeed, exhibits signs for the vowel as well as the consonantal ingredients of the syllables, three of the letters, namely, *haleph*, *yod*, and *waw*, being occasionally diverted from their original use to the purpose of vocal designation, the first of them with the power of A; the second, as E or I; and the third, as O or U; but where they are now, or rather where they formerly were so employed, (for in many places of the Hebrew text, characters are at present considered as vowel-letters, where the Greek rendering of the proper names clearly shows that they could not have been read as such at the time when the Septuagint translation was framed,) they constitute no part of the original writing, and were introduced into it by the Jews, after the Greek version had made them but very slightly acquainted with the value of such signs. Had they previously become more familiar with the subject, they would of course have adopted at least five vowel-letters instead of three, and they would have vocalized the whole of the text, instead of only about one-fifth part of it. But however imperfectly and irregularly this vocalization was made,—and the very imperfection and irregularity which are observable in it, now contribute to the proof of its human origin;—still at the time of its insertion it was a most providential addition to the sacred text, to preserve the true meaning of the word of God; an object which in most, though by no means in all instances, it has certainly effected.

The correctness of this statement respecting the adventitious nature of the Hebrew vowel-letters, is proved by the very large proportion of the discrepancies between the Hebrew text and Septuagint version, which can be removed by a different insertion of those letters in the original: and the proof thus supplied is confirmed by the Samaritan Pentateuch, in which, indeed, it is the same set of letters that are

employed as vowel signs, but they are inserted in quite a different manner, the *yod* and *waw* much more frequently, and the *haleph,* though not very often, yet oftener than in the Hebrew; whence it is clearly evident, that they were introduced into this text at a later period, and when the use of such signs had become better understood. It is further to be observed, that the same vocalization also pervades all the other kinds of Shemitic writing used in Asia, but is fuller, and, consequently, of later insertion in each of them than in the Hebrew. And as it is inconceivable that so very peculiar a system of vowel signs should have been adopted by different people independently of each other, the probability is, that the Jews alone derived it immediately from their acquaintance with Greek writing, and that the other Asiatic tribes of the Shemitic class took it from them.

On the other hand, the vocalization of the Abyssinian syllabary is wholly different from that which is common to every other species of Shemitic writing, and must have been derived from immediate observation of the Greek Scriptures; as the Ethiopic translation of the Bible affords very decisive evidence that it was made, not from the Hebrew original, but from the Septuagint version. Two of the letters, with their powers, are here subjoined as a specimen:

Taw.	ተ	ቱ	ቲ	ታ	ቴ	ት	ቶ
	tă	tu	ti	tā	tē	tĕ	to
Kaf.	ከ	ኩ	ኪ	ካ	ኬ	ክ	ኮ
	kă	ku	ki	kā	kē	kĕ	ko

The period when the first column of this syllabary was derived from some Shemitic alphabet cannot now be ascertained; but a limit to the age of the system, in its present improved form, can be deduced from ecclesiastical history; for the Abyssinians first received the Scriptures when they were converted to Christianity by Frumentius, who was consecrated bishop of Axum in the year of our Lord 335;

and there is not the slightest probability of their having studied the nature of Greek writing before it became to them the medium of religious instruction.

In order to compare the Abyssinian and Sanscrit syllabaries, it is necessary to leave out of consideration the vowel sounds, in the latter system, of *i* in *wine*, and of *ou* in *pound*, which do not occur in the Abyssinian language; as also the powers rĭ, rī, lĭ, lī, *an*, *ah*, which the Brahmans, through gross ignorance of the subject, have included among their vowels. After this reduction, the syllables denoted by the first of the Sanscrit letters will stand as follows:

क	का	कि	की	कु	कू	के	को
kă	kā	kĭ	kī	kŭ	kū	ke	ko

Each of the other letters undergoes similar modifications of shape for similar alterations of its syllabic powers.

Dr. Wall then proceeded to point out the close correspondence which subsists between the two systems. Of the many indications of their connexion, only two can be here noticed. 1. Whenever an Ethiopic letter has no mark added to it, the syllable it then denotes regularly ends in a short *a*; the same rule is also observed in the case of every Sanscrit letter. 2. Every syllable of the Ethiopic alphabet, as well as every simple syllable of the Ethiopic language, begins with a consonantal, and ends with a vocal power: the same remark applies to every syllable of the Sanscrit syllabary, but not to every simple syllable of the Sanscrit language.

A connexion between the two alphabets having been proved, the circumstance last noticed still farther serves to show the order which holds in that connexion, even without any reference to what has been already stated upon the origin of the Ethiopic alphabet. Of the systems compared together, the Sanscrit syllabary must have been that which was derived from the other; for it agrees with that other in a peculiarity suited to the Ethiopic, but not at all adapted

to the Sanscrit language, in which there are several syllables beginning with vowel sounds. To express such syllables the Brahmans were obliged to adopt the European method, as soon as their intercourse with the Greeks made them acquainted with it. Their persevering in the use of their syllabary after they had acquired vowel letters, shows that they were incapable of arriving at this improvement by their own efforts; and they could not have learned it from observation of any Shemitic writing, as in no kind of that writing are vowel letters found placed before consonants for the expression of simple syllables. Thus the writing in the Devanagari character at present exhibits the very extraordinary phenomenon of two different sorts of alphabets employed together; and it could not have been advanced to this state before the fifth, or perhaps before the sixth century; for the Pundits must have been long habituated to their syllabary alone, or they would have deserted it as soon as they came to learn the use of a superior alphabet.

In support of this view of the subject, Dr. Wall adduced several arguments from history, from astronomy, from the serious difficulties with which the opinion at present received is embarrassed, from the nature of the Sanscrit language, and from its grammatic structure.

Dr. Orpen presented the accounts, and petition to Parliament.

Ordered,—"That the seal of the Academy be annexed."

Resolved,—"That the Academy cannot receive the intimation of the vacancy that has occurred in Council since their last meeting, by the sudden and lamented death of their valued friend and associate, Dr. William West, without placing on record their sincere feelings of regret, at an event which has snatched from the successful pursuits of Science, one whose exertions had been honorably devoted to its cultivation, and had been endeared by his social and amiable

qualities to the affections of his personal friends, as much as to the friends of literature by his labours for its advancement."

RESOLVED,—"That the Council be directed to prepare and forward through the proper channel, an address to her Majesty, Queen Victoria, condoling with her on the death of his late Majesty, King William, congratulating her on her accessien to the throne, and requesting her Majesty's patronage for the Academy."

DONATIONS.

Transactions of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge. Vol. V. New Series. Part 3. Presented by the Society.

Mémoires de la Société Géologique de France. Vols. I. and II. Parts 1 and 2. Presented by the Society.

Bulletin de la Société Géologique de Franee. Tome VIII. Feuilles 1—20. 5 Numbers. Presented by the same.

General Charte der Geographischen Verbreitung und des Ganges der Cholera, 1816—37. By Emil Isensee. Presented by the Author.

Neues System zur Ubersicht der inneren Krankheiten des Menschen. By the same. Presented by the same.

Transactions of the Royal Society of Literature of the United Kingdom. Vol. III. Part 1. Presented by the Society.

Royal Society of Literature.—Annual Report.—President's Address.—List of Members, 1837. Presented by the same.

Memorias da Academia R. das Sciencias de Lisboa. Tomo XII. Parte 1. Presented by the Society.

Transactions of the Statistical Society of London. Vol. I. Part 1. Presented by the Society.

County Book of Kildare, Lent Asssizes, 1835. Presented by Jeffries Kingsley, Esq.

Astronomische Nachrichten. By H. H. C. Schumacher. Also Nos. 312—326. Presented by the Author.

Account of some Experiments made in different Parts of Europe on Terrestrial Magnetical Intensity, particularly with Reference to the Effect of Height. By James D. Forbes, Esq., F. R. SS. L. and E., F. L. S. Presented by the Author.

On the Temperatures and Geological Relations of certain Hot Springs, particularly those of the Pyrenees; and on the Verification of Thermometers. By the same. Presented by the same.

Note relative to the supposed Origin of the deficient Rays in the Solar Spectrum: being an Account of an Experiment made at Edinburgh during the annular Eclipse of 15*th May*, 1836. By the same. Presented by the same.

Ancient and Modern Alphabets of the popular Hindoo Languages of the Southern Peninsula of India. By Captain Henry Harkness, M. R. A. S. Presented by the Author.

Proceedings of the Royal Asiatic Society of Great Britain and Ireland.—Anniversary Meeting, and Fourteenth Annual Report of the Council, &c. Presented by the Society.

Researches on Hydrodynamics. By John Scott Russell, Esq. M. A., F. R. S. E. Presented by the Author.

Histoire des Maladies observées a la grande Armée Francaise, pendant les Campanes de Russie en 1812, *et d'Allemagne en* 1813. Par le Chevalier de Kerckhove dit de Kirckhoff. Presented by the Author.

Journal of the Franklin Institute of the State of Pensylvania and Mechanics' Register. Vol. XIX. New Series. Edited by Thomas P. Jones, M. D. Presented by the Franklin Institute.

Report of the Committee of the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts on the Explosion of Steam Boilers, of Experiments made at

the request of the Treasury Department of the United States. Part II. Presented by the same.

De l'Affinité des Langues Celtiques avec le Sanscrit. Par Adolphe Pictet. Presented by the Author.

Proceedings of the Geological Society of London, Nos. 47—51 ; *together with a List of the Society, April 1st,* 1837. Presented by the Society.

The History of the Presbyterian Church in Ireland. Vol. II. By James Seaton Reid, D.D., M.R.I.A. Presented by the Author.

Études Grammaticales sur la Langue Euskarienne. Par A. Th. d'Abbadie, et J. Augustin Chaho, de Navarre. Presented by the former.

Natuur kundige Verhan delingen van de Hollandske Maatschappij der Wetenschappen te Haarlem. From Vol. XIII. to XXXIII. Presented by the Dutch Society.

Reports of the British Association for the Advancement of Science. 5 Vols. Presented by the Association.

November 30. (Stated Meeting.)

His Grace the ARCHBISHOP OF DUBLIN, V. P., in the Chair.

The Secretary of the Council having officially communicated the decease of the President,

IT WAS RESOLVED,—" That no further business should be proceeded in, until the next Meeting of the Academy, on Monday, December 11th, when it was resolved, that the President, in place of Dr. Lloyd, and the new Member of Council, in place of Dr. West, should be elected."

Adjourned to Monday, December 11th, 1837.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1837—1838. No. 8.

December 11, 1837.

Rev. F. SADLEIR, D. D., Provost, T. C. D., Vice-President, in the Chair.

The Academy having proceeded to ballot for a President, Sir William Rowan Hamilton was duly elected.

The Academy having proceeded to ballot for a Member of Council in the Committee of Polite Literature, the Rev. Charles Wm. Wall, D. D. was elected.

The Very Rev. James Gregory, Dean of Kildare, John Finlay, Esq. Barrister, Samson Carter, Esq., and George Pim, Esq. were elected Members of the Academy.

Adjourned to Monday, January 8th, 1838.

DONATIONS.

Ricerche sulla Struttura del caule nelle Piante Monocotiledoni di Guiseppe Meneghini. Presented by Samuel Litton, M. D., Vice-President.

Astronomische Nachrichten, herausgegeben von H. C. Schumacher. Vierzehnter Band. From No. 327 to 336, inclusive. Presented by Professor Schumacher.

On the Elements of the Orbit of Halley's Comet, at its Appearance in the Years 1835 *and* 1836. By Lieutenant W. S. Stratford, R. N. (From the Nautical Almanac for 1839.) Presented by the Author.

The American Almanac and Repository of Useful Knowledge, for the Year 1838. Presented by the American Philosophical Society.

January 8, 1838.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The President, on taking the Chair, delivered an Address to the Academy.

The Secretary of the Academy read a Memoir of the late President.

RESOLVED,—"That the President and Dr. Singer be requested to furnish the Academy with copies of their respective addresses."

The Academy then proceeded to ballot for a Member of Council in the Committee of Science, when Dr. Wm. Stokes was elected.

DONATIONS.

A Treatise on the Diagnosis and Treatment of Diseases of the Chest. By Wm. Stokes, M. D., M. R. I. A. Presented by the Author.

Essays, Anatomical, Zoological, and Miscellaneous. By A. Jacob, M. D., M. R. I. A. Presented by the Author.

The Anatomy of the Eye, from the Cyclopædia of Anatomy and Physiology. By Dr. Jacob. Presented by the same.

List of Members of the Royal Asiatic Society of Great Britain and Ireland, 1837. Presented by the Society.

Medical Science and Ethics; an Introductory Lecture, delivered at the Bristol Medical School, on Monday, October 2nd, 1837, *at the opening of the Winter Session.* By W. Ogilvie Porter, M. D. Presented by the Author.

The Question of Privilege, raised by the Decision in the Case of Stockdale v. *Hansard.* By S. A. Ferrall, Esq., Barrister at Law. Presented by the Author.

A Complete Set of the Transactions of the Italian Society of Sciences. 39 vols. 4to. Presented by the Society.

INAUGURAL ADDRESS

BY THE PRESIDENT.

My Lords and Gentlemen of the Royal Irish Academy,

The position in which your kindness has placed me, entitles me, perhaps, to address to you a few remarks. Called by your choice to fill a chair, which Charlemont, and Kirwan, and others, not less illustrious, have occupied, I cannot suffer this first occasion of publicly accepting that high trust to pass in silence by, as if it were to me a thing of course. Nor ought I to forego this natural opportunity of submitting to you some views respecting the objects and prospects of this Academy, which, if they shall be held to have no other interest, may yet be properly put forward now, as views, by the spirit at least of which I hope that my own conduct will be regulated, so long as your continuing approbation shall confirm your recent choice, and shall retain me in the office of your President.

First, then, you will permit me to thank you for having conferred on me an honour, to my feelings the most agreeable of any that could have been conferred, by the unsolicited suffrages of any body of men. Gladly indeed do I acknowledge a belief, which it would pain me not to entertain, that friendship had, in influencing your decision, a voice as potent as esteem. An Irishman, and attached from boyhood to this Academy of Ireland, I see with pleasure in your choice a mark of affection returned. But knowing that the elective act partakes of a judicial character, and that the exercise of friendship has its limits, I must suppose that the same long attachment to your body, which had won for me your personal regard, appeared also to you a pledge, more strong than promises could be, that if any exertions of mine could prevent the interests of the Academy from suffering through your generous confidence, those exertions should not be withheld; and that you thought they might not be entirely unavailing. After every deduction for kindness, there remains a manifestation of esteem, than which I can

desire no higher honour, and for which I hope that my conduct will thank you better than my words.

And yet, Gentlemen, it is to me a painful thought, that the opportunity for your so soon bestowing this mark of confidence and esteem has arisen out of the deaths, too rapidly succeeding each other, of the two last Presidents of our body, who, while they are on public grounds deplored, and for their private worth were honoured and beloved by all of us, must ever be remembered by me with peculiar love and honour:—Brinkley, who introduced me to your notice, by laying on your table long ago my first mathematical paper; and Lloyd, whose works, addressed to the University of Dublin, first opened to me that new world of mind, the application of algebra to geometry. But of these personal feelings, the occasion has betrayed me into speaking perhaps too much already. Into that fault, I trust, I shall not often fall again. I pass to the exposition of views respecting the objects and prospects of our Society.

The Royal Irish Academy was incorporated (as you know) in 1786, having been founded a short time before, for the promotion generally, but particularly in Ireland, of Science, Polite Literature, and Antiquities. Its objects were to be the *True*, the *Beautiful*, and the *Old*: with which ideas, of the True and Beautiful, is intimately connected the coordinate (and perhaps diviner) idea of the *Good*. So comprehensive, therefore, was the original plan of this Academy, that it was designed to include nearly every object of human contemplation, and might almost be said to adapt itself to all conceivable varieties of study; insomuch that scarce any meditation or inquiry is directly and necessarily excluded from a place among our pleasant labours: and precedents may accordingly be found, among our records, for almost every kind of contribution. If only a diligence and patient zeal be shown, such as befit the high aims of our body; and if due care be taken, that the spirit of love be not violated, nor brother offend brother in anything; no strict nor narrow rules prevent us from receiving whatever may be offered to our notice, with an indulgent and joyful welcome. And though we meet only as studious, meditative men, and abstain from including among our objects any measures of immediate, outward, practical utility, such as improvements in agriculture, or other useful arts,—a field which had been occupied, in this metro-

is, by another and elder society, before the institution of our
ı; yet no philosopher nor statesman, who has reflected suffi-
ıtly on the well-known connexion between theory and practice,
on the refining and softening tendencies of quiet study, will
ık that therefore we must necessarily be useless or unimportant
a body, to Ireland, or to the Empire.

The *object* of this Academy being thus seen to be the encourage-
nt of STUDY, we have next to consider the *means* by which we are
accomplish, or to tend towards accomplishing that object. Those
ans are of many kinds, but they may all be arranged under the two
at heads of *inward* and *outward* encouragement; or, in other
rds, *stimuli* and *assistances;* in short, SPURS and HELPS to study.
e encouragement that is given may act as supplying a motive,
as removing a hindrance; it may be indirect, or it may be
rect; invisible or visible; mental or material. Not that these
o great kinds of good and useful action are altogether separated
m each other. On the contrary, they are usually combined;
d what gives a stimulus, gives commonly a facility too. In our
eetings, for example, the *stimulating* principle prevails; yet in
em we are not only caused to feel an increased *interest* in study
nerally, through the operation of that social spirit, or spirit of
mpathy, of which I spoke so largely, in the presence of most of
u, at the meeting of the British Association* in this city; but
so are directly *assisted* in pursuing our own particular studies, by
ving the results of other studious persons early laid before us,
d commented upon, by themselves and by others, in a fresh
miliar way. We are not only spurred but helped to study, by
ixing freely with other students.—A *library*, again, is designed
ther to *assist* than to stimulate; and yet it is impossible for a
rson of ardent mind to contemplate a well selected assemblage of
oks, containing what Milton has described as "the precious life-
ood of a master-spirit, embalmed and treasured up on purpose to a
e beyond life," without feeling a deep desire to add, to the store
ready accumulated, some newer treasure of his own. Our

* See the Address printed in the Fifth Report of the British Association for the
lvancement of Science,—*Note by* PRESIDENT.

library, then, spurs as well as helps.—The *prizes* which from time to time we award for successful exertion in the various departments of study, might seem to be *stimulants* only; yet if we were to act sufficiently upon the spirit of precedents, of which we have several among our past proceedings, and which allow us to make our awards in part pecuniary, as well as honorary, they might become important *assistances*, and not merely *excitements* to study; they might serve, for instance, to enrich the private libraries of the authors on whom they were conferred. Why might we not, for example, instead of giving one gold *medal*, which can (according to the custom of this country) only be gazed at for a while and then shut up, allow the author who has been thought worthy of a prize to select any *books* for himself, which he might think most useful for his future researches, within a certain specified limit of expense; and then not only purchase those books for him out of our own prize funds, but also stamp them with the arms of the Academy, or otherwise testify that they were given to him by us as a reward? Or might not some such presentation of books be at least combined with the presentation of medals? But the whole system of prizes will deserve an attentive reconsideration, for which this is not the proper time nor place; and anything that I may now have said, or may yet say on that subject, in this address, is to be looked upon as merely intended to *illustrate* a few general *views* and principles, and not as any *proposal* of *measures* for your adoption; since, upon measures of detail, I have not as yet even made my own mind up; and am aware that, by the constitution of our Society, all measures of that kind must first be matured in the Council, before they are submitted to the Academy at large for final sanction or rejection.

The publication of our *Transactions* is another field of action for our body, and perhaps the most important of all; in which it is not easy to determine whether the stimulating or the assisting principle prevails; so much both of inducement and of facility do they give to study and to its communication. It is indeed a high reward for past, and inducement to future labours, to know that whatever of value may be elicited by the studies of any members of this body, (nor are we to be thought to wish to *confine* the advantage to *them*,) is likely or rather is sure to be adopted by the Society at

large, and published to the world, at least to the learned world, in the name and by the order of the whole:—the responsibility for any errors of detail, and the credit for any merit of originality, remaining still in each case with the author, while the Academy exercises only a right of preliminary or *primâ facie* examination, and a superintendence of a general kind. Nay, the more rigorous this preliminary examination is, and the more strict this general superintendence, the greater is the compliment paid to the writer whose productions stand the test; and the more honourable does it become to any particular essay, to be admitted among the memoirs of a Society, in proportion as those memoirs are made more select, and expected and required to be more high. But besides this honorary stimulus, which we should all in our several spheres exert ourselves to make more effective, by each endeavouring, according to his powers, to contribute, or to judge, or to diffuse, there is also a powerful and direct *assistance* given to study, by the publishing of profound intellectual works at the expense of a corporate body, rather than at the expense of individuals; a course which spares the private funds of authors and of readers; and thus procures, for the collections of learned and studious men, many works of value, which otherwise might never have appeared. Indeed, the publication of Transactions has long been regarded by me as the most direct and palpable advantage resulting from the institution of scientific and literary societies like our own; and, I believe, that I expreessed myself accordingly, on the occasion* to which I lately alluded. But having *then* to deal with science only, I felt that it was unnecessary, and would have been improper for me to have introduced any view of the connexion and contrast between science and other studies, which are, not less than science, included among the objects of this Academy, and may therefore be fitly, if briefly, brought now before your notice. The union of all studies is indeed that at which we aim; but the three great departments, which our founders distinguished without dividing, may now also with advantage be distinctly considered, and separated, that they may may be re-combined; a clearness of conception being likely to be thus attained, without any sacrifice of unity.

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* See Address, already cited, p. xlvi.—*Note by* PRESIDENT.

Directing our attention, therefore, first to science, or the study of the True,—

Inter sylvas Academi quærere verum,—

we find that, even when thus narrowed, the field to be examined is still so wide as to make necessary a minuter distinction; whether we would inquire, however briefly, what has been already done by this Academy, or what may fitly be desired and hopefully proposed to be done. Were we to rush into this inquiry without any previous survey of its limits, and, as were natural, allowed ourselves to begin by considering the actual and possible relation of our studies to the primal science, or First Philosophy, the Science of the Mind itself; we might easily be drawn, by the consideration of this one topic, into a discussion, interesting indeed, and (it might be) not uninstructive, but of such vast extent as to leave no room for other topics, which ought even less to be omitted, because they have hitherto come, and are likely to come hereafter, more often than it before our notice, in actual contributions to our Transactions. Indeed I think it prudent at this moment to resist altogether the temptation of expatiating on this attractive theme, of Philosophy, eminently so called; and to content myself with remarking, that as metaphysical investigation has more than once already found place among the scientific labours of this Academy, so ought it to take rank among them still, and to reappear in that character, from time to time, in our pages.

Confining ourselves, therefore, at present to Science, in the usual acceptation of the term, and inquiring what are its chief divisions, in relation mainly to the connected distribution or classification of scientific essays in our Transactions, we soon perceive that three such parts of science may conveniently be distinguished from each other, and marked out for separate consideration; namely those three, which, with some latitude of language, are not uncommonly spoken of as Mathematics, Physics, and Physiology. The first, or *mathematical* part, being understood to include not only the pure but the mixed mathematics; not only the results of our original intuitions of time and space, but also the results of the combination of those intuitions with the not less original notion of cause, and with the observed laws of nature, so far and no farther than that

ever-widening sphere extends, within which observation is subordinate to reasoning; in short, all those deductive studies, in which Algebra and Geometry are dominant, though the dynamical and the physical may enter as elements also. The second, or *physical* part of science, embracing all those inductive studies respecting unliving or unorganized bodies, which proceed mainly through outward observation or experiment, and can as yet make little progress in "the high *priori* road." And finally, the third, or *physiological* part, including all studies of an equally inductive kind, respecting living or organized bodies. (I do not pretend that this arrangement is the most philosophical that can be imagined, but it may suffice for our present purpose.)

In all these divisions of science, and in several subdivisions of each, our published Transactions contain many valuable essays; and there seems to be no cause for apprehension that in *this* respect, at least, (if indeed in any other,) the Academy is likely to lose character. Death has, it is true, removed some mighty names from among us—elders and chiefs of our society: but the stimulus and instruction of their example have not been thrown away: an ardent band of followers has been raised up by themselves to succeed them. To keep the trust thus handed down, is an arduous, but noble charge, from which it is not to be thought that any here will shrink, whatever his share of that charge may be.

And yet, while Mathematics and Physics seem likely not to be neglected here, or rather certain to be ardently pursued, it may be pardoned me if I express a fear and a regret, that Physiology, or more precisely, the study of the phenomena and laws of life, and living bodies, has not been represented lately in the published Transactions of our Academy, to a degree correspondent with the eminence of the existing School of physiological study in Dublin. Our medical men and anatomists, our zoölogists and botanists also, will take, I hope, this little hint in good part. They know how far I am from pretending to criticize their productions, and that I only wish to have more of their results brought forward here, for the instruction of myself and of others. *That* is not, I think, too much to ask from gentlemen who have subscribed the obligation which is signed by every member of this

body, and who are qualified, by intellect and education, to take an enlarged yet not exaggerated view of the importance of a central society. I know that many other, and indeed more appropriate outlets exist, for the publication of curious, isolated, or semi-isolated facts : but it is not so much remarkable *facts*, as remarkable *views*, that I wish to see communicated to us, and through us to the world; although such views ought, of course, to be illustrated and confirmed by facts.

It seems possible, that in each of the three great divisions of science already enumerated, our Transactions may be enriched in future, through a judicious system of rewards, (of the kinds to which I lately alluded,) intended to encourage contributions of a more elaborate kind than usual, from strangers as well as from members of our body. It has appeared, for example, to some members of your Council, and to me, that for each of those three divisions of science a *triennial prize* might be given ; these three triennial prizes succeeding each other in such rotation, for mathematics, physics, and physiology, that a prize should be awarded every year, on some one principal class of scientific subjects, for the best essay which had been communicated for publication, on any subject of that class, whether by a member or by a stranger, during the three preceding years. A plan of this sort has been lately tried, and (it would seem) with advantage, in the distribution of the Royal Medals entrusted by the late King* to the Royal Society of London; and the principle is not unsanctioned by you, that a greater range of investigation may sometimes be allowed to the authors of prize-essays, than the terms of an ordinary prize-question would allow. So that it only remains for your Council to consider and report to you, as they are likely soon to do, to what extent this principle may advantageously be pushed, and by what regulations it may conveniently be carried into effect. In saying this, I do not presume to pronounce that it is expedient to give up entirely the system of proposing occasionally prize-questions, of a much more definite kind than those to which I have been referring

* And continued by her present Majesty: whose gracious intention of becoming Patroness of the Royal Irish Academy has been made known since the delivery of this Address.—*Note by* PRESIDENT.

as desirable; but thus much I may venture to lay down, that original genius in inquirers ought to be as far indulged as it is possible to indulge it, both in respect of subject and of time; and that due time ought also to be allowed to those members of a Scientific Society, on whom is put the important and delicate office of pronouncing an award in its name.

The length at which I have spoken of our relations to Science, as a Society publishing Transactions, though far from exhausting that subject, leaves me but little room, in this address, to speak of our relations to Literature and Antiquities; subjects to which, indeed, I am still less able to do justice, than to that former theme. But the spirit of many of my recent remarks applies to these other subjects also; and you will easily make the application, without any formal commentary from me. A word or two, however, must be said on some points of distinction and connexion between the one set of subjects and the other.

As, in Science, or the study of the *True*, the highest rank must be assigned to the science of the investigating Mind itself, and to the study of those Faculties by which we become cognizant of truth; so, in Literature, or the study of the *Beautiful*, the highest place belongs to the relation of Beauty to the mind, and the study of those essential Forms, or innate laws of taste, in and by which, alone, man is capable of beholding the beautiful. Above all particular fair things is the Idea of Beauty general: which in proportion as a man has suffered to possess his spirit, and has, as it were, won down from heaven to earth, to irradiate him with inward glory, in the same proportion does he become fitted to be a minister of the spirit of beauty, in the poetry of life, or of language, or of the sculptor's, or the painter's art. The mathematician himself may be inspired by this in-dwelling beauty, while he seeks to behold not only truth but harmony; and thus the profoundest work of a Lagrange may become a scientific poem. And though I am aware that little can be communicated by expressions so general (and some will say so vague) as these, and check myself accordingly, to introduce some remarks more specific and definite; yet I will not regret that I have thus for a moment attempted to give words to that form of emotion, which many here will join with me in acknowledging to be the ultimate spring of all genuine and genial

criticism, in literature and in all the fine arts. For we, in so far as we are an Academy of Literature, are also a Court of Criticism;—Criticism which is to Beauty, what Science is to Nature. Between the divine of genius and the human of enjoyment, we hold a kind of middle place; creating not, nor merely feeling, but aspiring to understand: and yet incapable of rightly understanding, unless we at the same time sympathize.

To express myself then in colder and more technical terms, I should wish that metaphysico-ethical and metaphysico-æsthetical essays,—those which treat generally of the beautiful in action and in art, and are connected rather with the study of the beauty-loving mind itself, than of the particular products or objects which that mind may generate or contemplate,—should be considered as entitled to the foremost place among our literary memoirs. After these *à priori* inquiries into the PRINCIPLES of beauty, which are rather *preparatory* to criticism than criticism itself, or which, at least, deserve to be called *criticism universal*, should be ranked, I think, that important but *à posteriori* and inductive species of criticism, which, from the study of some actual master-pieces, collects certain great RULES as *valid*, without deducing them as *necessary* from any higher principles. And last, yet still deserving of high honour, I would rank those researches of DETAIL, those particulars, and helps, and applications of criticism, which, if they be, in a large philosophical view, subordinate and subsidiary to principles, and to rules of universal validity, yet form perhaps the larger part of the habitual and ordinary studies of men of erudition; such as the differences and affinities of languages, and the explication of obscure passages in ancient authors. Whatever metaphysical preference I may feel for inquiries of the two former kinds, no one, I hope, will misconceive me as speaking of this last class of researches with any other feelings than those of profound respect, and of desire and hope to see them cultivated here; nor as presenting other than hearty congratulations to the Academy on the fact, that whereas no single paper on Literature appeared in our last volume, two memoirs, interesting and erudite, have been presented to us, and probably are by this time printed, to be in readiness for our next publication;—one, on the Punic Passage in Plautus, by a near and dear relative of my own; and the other, on the Sanscrit

Language, by a gentleman of great attainments and of high station in our national University: from which seat of learning, it seems not too much to hope, that we shall soon receive many other contributions in the department of Polite Literature, as well as in other departments. It is, of course, understood that the awarding of prizes is not to be confined to scientific papers, but is to be extended, as indeed it has always been, under some convenient regulations, to literary and antiquarian papers also.

I was to say a few words respecting that other department of our Transactions, namely, Antiquities, or the study of the Old; and if, at this stage of my address, those words must be very few, I regret this circumstance the less, because I know that the study is deservedly a favourite here, and that I am surrounded by persons who are, beyond all comparison, more familiar with the subject than myself.

In general, I may say, that whether the study of Antiquities be regarded in its highest aspect, as the guardian of the purity of history,—the history of nations and of mankind; or as ministering to literature, by recovering from the wreck of time the fragments of ancient compositions; or as indulging a natural and almost filial curiosity to know the details of the private life of eminent men of old, and to gaze upon those relics which invest the past with reality, as the palæontologist from his fossils reconstructs lost forms of life: in all these various aspects, the study is worthy to interest any body of learned men, and to occupy a considerable part of the Transactions of any society so comprehensive as our own. The historian of the Peloponnesian war was also himself an antiquarian; and prefaced that work which was to be "a possession for ever," by an inquiry into the antiquities of Greece. And while he complained of the οὕτως ἀταλαίπωρος τοῖς πολλοῖς ἡ ζήτησις τῆς ἀληθείας, that easy search after truth which cost the multitude nothing; he also claimed to have arrived at an ἑξῆς τεκμηρίων, a linked chain of antiquarian proof, by which he could establish his correction of their errors. Indeed, the uninitiated are apt to doubt,—perhaps too they may sometimes smile,—when they observe the earnest confidence which the zealous Antiquary reposes in results deduced from arguments which seem to them to be but slight; nor dare I say that I

have never yielded to that sort of sceptical temptation. But I remember a *fact* which ought to have given me a lesson, on the danger of hastily rejecting conclusions which have been maturely considered by others. A learned Chancellor of Ireland, now no more, assured me often and earnestly, that he gave no faith to the inductions of astronomers respecting the distances and sizes of the sun and moon; and hinted that he disliked our year, for containing the odd fraction of a day. Yet this was a man, not only of great private worth, but of great intellectual power, and eminent in his profession as in the state. Astronomers and mathematicians, it may be, look sometimes on other inductions with a not less unfounded incredulity. It is one of the advantages of an Academy, so constituted as ours is, that it brings together persons of the most different tastes and the most varied mental habits, and teaches them an intellectual toleration, which may ripen into intellectual comprehension. Thus, while the antiquary catches from the scientific man his ardent desire for progression, and for that clearer light which is future, the man of science imbibes something in return, of the antiquarian reverence for that which remains from the past. The literary man and the antiquary, again, re-act upon each other, through the connexion of the Beautiful and the Old, which in conception are distinct, but in existence are often united. And finally, the scientific man learns elegance of method from the man of literature, and teaches him precision in return.

Before I leave the subject of Transactions, I may remark that their value, both as stimulants and as assistants to study, must much depend on the rapidity and extent of their circulation, and on the care that is taken to put them as soon as possible into the hands or within the reach of studious men abroad. Reciprocally it is of importance that measures should be taken for obtaining speedy information here of what is doing by such men in other countries. On both these points, some reforms have lately been made, but others still are needed, and will soon be submitted to your Council. On these and all questions of improvement, I rely upon receiving the assistance of all those gentlemen who are in authority among us; but especially am encouraged by the hope of the cordial co-opera-

tion of your excellent Vice-President, Professor Lloyd, who has done so much already for this Academy, in these and in other respects.

It may deserve consideration, as connected with the last-mentioned point, whether Reports upon some foreign memoirs of eminent merit, accompanied by extracts, and, perhaps, translations, might not sometimes be advantageously called for. There is, I think, among our early records, some hint that the Academy had once a paid Translator. It may or it may not be expedient to revive the institution of such an office; or to give direct encouragement to the exertions of those,* who, without any express reference to our own body, work in this way for us, while working for the public; but no one can doubt that it is desirable to diminish the too great isolatedness which at present exists among the various learned bodies of the world. The Reports of the British Association on the actual state of science in each of its leading subdivisions, do not exactly meet the want to which I have alluded; because, upon the whole, they aim rather at condensing into one view the ultimate *conclusions* of scientific men in general, than at diffusing the fame and light of individual scientific genius, by selecting some few great foreign works, and making known at home their *method* as well as well as their results. Besides we must remember that far as that colossal Association exceeds the body to which we belong, in numbers, wealth, and influence, yet in plan it is less comprehensive; since it restricts itself to science exclusively, while we aspire, as I have said, to comprehend nearly the whole sphere of thought,—at least of thought as applied to merely human things: in making which last reservation, I shall not, I hope, be supposed wanting in reverence for things more sacred and divine.

With that powerful and good Association, however, we should endeavour to continue always on our present, or if possible, on closer terms of amicable relation. I need not say that we should also aim to preserve and improve our friendly relations with all the

* For instance, Mr. Richard Taylor, of London, F. S. A., &c., who lately began to publish *Scientific Memoirs*, selected and translated from the Transactions of Foreign Academies of Science, and other foreign sources; which valuable publication is now suspended for want of sufficient support from the public.—*Note by* PRESIDENT.

other Scientific, Literary, and Antiquarian Societies, of these and of foreign countries. Especially we ought to regard, with a kind of filial feeling of respect and love, the Royal Society of London—that central and parent institution, from which so many others have sprung; over which Newton once presided; and in which our own Brinkley wrote. While feelings of this sort are vigilantly guarded, and public and private jealousies excluded vigilantly, a vast and almost irresistible moral weight belongs to companies like these, of studious men; and, amid the waves of civil affairs, the gentle voice of mind makes itself heard at last. Societies such as ours, if they do their duty well, and fulfil, so far as in them lies, their own high purpose, become entitled to be regarded as being, on all purely intellectual and unpolitical questions, hereditary counsellors of crown and nation. The British Association has already made applications to government with success, for the accomplishment of scientific objects; and I am not without hopes that our own recent memorial, for the printing, at the public expense, of some valuable manuscripts in our possession, adapted to throw light on history, and interesting in an especial degree to us as Irishmen, will receive a favourable consideration.

On the present occasion, which to me is solemn, and to you not unimportant, I may be pardoned for expressing, in conclusion, the pleasure which it gives me to believe, that while we cautiously abstain from introducing polemics or politics, or whatever else might cause an angry feeling in this peaceful and happy society, some great and fundamental principles, of duty to heaven and to the state, are universally recognized amongst us. Admitted at an early age to join your body, I now have known you long, and hope to know you longer; but have never seen the day, and trust that I shall never see it, when piety to God, or loyalty to the Sovereign, shall be out of fashion here.

MEMOIR OF THE LATE PRESIDENT,

BY THE REV. J. H. SINGER, D.D.,

SECRETARY OF THE ACADEMY.

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rHE lives of men of science are proverbially devoid of incident; bstracted from the bustle and business of the great world withut, and deriving their happiness as well as their occupation from he little world within, we but seldom find them influenced by the icissitudes that shed the interest of adventure over the course of he legislator, the diplomatist, or the warrior. Even the steps hat have led the scholar to eminence, the light that first dawned pon the path of invention, and the process by which conjecture as been gradually matured to certainty,—even these are too freuently unknown; and though they present the most interesting roblems in intellectual science, are sometimes concealed by the odesty of him who is their subject, and sometimes forgotten r dimmed to recollection by the splendour of advancing discoery. The life of our late President, though so important in its elation to the progress of education and science in this country, urnishes no exception to the general statement we have made; and lthough his mind must have nurtured for years the germs of improvement by which his memory has been made illustrious, it was the silence and secrecy of his own solitary reflections.

BARTHOLOMEW LLOYD was born in the year 1772, and having een at an early period of life deprived both of his father and of his ncle, to whose care he had been committed after his father's death, entered soon upon those struggles with the world in which, by ergy and perseverance, he was to obtain so signal a victory. At e age of fifteen he entered the University, and by his talents and asuity soon made himself conspicuous, obtaining successively a Schoship and Fellowship in 1790, and 1796, on high and distinguished swering. On the numerous but important duties that devolved him as tutor, or on the manner in which he fulfilled them, it is necessary to dilate. The affectionate recollections of his nume-

rous pupils, many of whom have attained to rank and respectability, and many of whom surround me, prove equally the interest he took in their welfare, and his exertions to secure it; while the knowledge he acquired in Mathematics and Natural Science, evince that his *horæ subsecivæ*, were not devoted to personal ease or relaxation. His character for labour and research was sufficiently developed to justify his appointment, while a Junior Fellow, to the Professorship of Mathematics, on Dr. Magee, the late Archbishop of Dublin, retiring from that situation: and some years afterwards, to that of Natural Philosophy. To the manner in which he filled those important stations, academic and public opinion has long since given its approbation; and it was in full accordance with that opinion, loudly and unanimously expressed, that when the present Bishop of Cork was raised to that see, Dr. Lloyd was elevated from among the Fellows of the University, to preside as Provost over its interests.

This event, hailed by every friend of science and education, took place in 1831, and perhaps no six years in the history of any institution can be compared to those which passed under his brief administration, with regard to substantial improvement, changes rapid, though well weighed, and reform mild and prudent, yet searching and effective. Scarcely a portion of the system of education but was subjected to consideration, and in many instances to changes fully justified by experience; and while we now look back with astonishment upon all that the energy and discrimination of one man could effect, we must not withhold our high approbation from those, who, unimpeded by any love of system, or habit, or prejudice, seconded so nobly his exertions: and we may rejoice that he was enabled to compass such a mass of reform, without experiencing a failure, and without endangering a friendship. On the regretted death of our President, the justly esteemed Bishop of Cloyne, the choice of the Academy almost unanimously devolved on Dr. Lloyd; and he who had shewn himself the active, intelligent, and instructed patron and promoter of every useful science, himself no mean proficient in all,—he who mainly by his influence and character had collected here the representatives of science from every quarter of the globe, and made the metropolis of Ireland, for the season, that of natural knowledge,—he was elected almost by acclamation to preside over the meetings of the Royal

Irish Academy, many of whose members had felt the fostering of his kindness, and his friendship, and his direction in earlier life. But for two short years has he presided over this institution, years marked by unremitting attention upon his part to its interests; and although its present maturity of usefulness and exertion can scarcely be traced to his personal influence, over that exertion he carefully watched, with its progress he sincerely sympathized, and by every means in his power stimulated and applauded. A large portion of the morning of his lamented removal was occupied in tracing and rejoicing over the successive improvements of this Academy; and anticipating with melancholy pleasure its still further advancement. I say *melancholy*, for with that species of darkened feeling, which "the shadow of coming events" frequently produces, the Provost did not expect to witness its growth in prosperity, and he spoke of it as of a dear friend from whom he must expect to be parted, but who should have his best and sincerest wishes; as of a child to whom he would bequeath a legacy of anxious, affectionate, and longing remembrances. Such we may feel convinced was the emotion with which our late President regarded this institution, and it is a claim upon our grateful recollection of departed worth, that so long as any thing merely earthly occupied his attention, our interests and our welfare were entwined with his latest aspirations.

A few observations upon the claims which our late President, as a man of letters and science, has upon the gratitude of the literary and scientific public, will fitly close this brief memorial. When Dr. Lloyd was called to the Mathematical chair of the University, that science was at a low ebb in Ireland. The names and examples of Brinkley and Davenport, and a few others, had failed to produce any effect, and the misinterpreted and mistaken glory of Newton had formed here as well as elsewhere a barrier to the progress of his followers in the sciences he had made illustrious, and prevented them using for their further development the very instruments he had himself discovered and employed. This our President had seen, and over it he had mourned; and the first object of his exertions when enabled to speak with authority to the Academic youth, was to incite them to new fields of labour, to point out new regions to investigate and subdue; he exhibited himself as their fellow-student and fellow-workman, sharing their difficulties and rejoicing in their

triumphs. Nor did he only urge them forward; he held up a torch to direct their steps, and his elementary works upon Geometrical Analysis and Mechanics, adopted as the Text-books in the University, prove how completely he identified himself with the progress of the student, while at the same time they illustrate the power of that mind which could grapple with and overcome the most difficult of all intellectual labours, the rendering familiar and facile the elements of science. And our President was successful. The mind of our youth required but to be stimulated and directed. We are now as it were centuries in advance of what we, a few years ago, viewed as the limit of attainment, and many, whom to praise would be superfluous, and whom I would name, but that they are present, form the best comment on our President's zeal and foresight.

As Provost, the same great objects were ever present to his mind. Education, over which he presided, called for his undivided attention, and he bestowed it; and by the changes which he effected in its literary, scientific, and ethical departments, he has acquired for himself among the friends of the mind of Ireland imperishable glory. This is not the place to speak in detail of the many improvements he suggested or adopted; of the different courses of study which he supplied to the differing inclinations or tendencies of mind; of the elevation of mental and moral science to the station, which, in such a country as ours, it should maintain; of the separation of the important duties of the Professor from the laborious and important, but subordinate, occupation of the Tutor; still less of the zeal with which he watched over the theological course of the University, and laboured to raise it to meet the exigencies of the times, and the wants of the people. If the prosperity of a country be inseparably connected with the education of the higher and middle classes of the population, and if the progress of science and literature be the never-failing index of a civilized and moralized population, then must the individual who extends or improves education be ranked among the truest lovers of their country, and the name of Lloyd will be handed down among the benefactors of Ireland.

Nor was our late President exclusive in his attachment to Science or to Instruction; while the medical school connected with the University received his fullest consideration, and enjoyed the advantages of his reforms,—on natural science, in all its branches, he bestowed

his attention and his patronage. Of one Society (the Geological) he was, I believe, one of the original founders, as well as one of its first Presidents, and always an anxious and zealous member; under his auspices was the Magnetic Observatory commenced in the University, which promises to supply so perfectly a desideratum in British Science, and which must so powerfully tend not only to the elucidating of the most recondite and interesting problems in natural knowledge, but to the practical improvement of many of the most important instruments of general utility; and the very latest plan proposed by him to the Board of the University, was one for extending instruction in natural history, and rendering the acquisition of information in its varied departments more accessible. To mental science he had paid in early life considerable attention, and the respect he felt for it is manifest in the creation of the professorship of Moral Philosophy. All who have heard him as a preacher in the University must remember the clear and lucid style, the mild and earnest, and persuasive manner which, in spite of physical defects, rendered him most attractive in the pulpit; and they cannot forget the accuracy of conception, and keen and discriminating judgment which could penetrate into the depths of the metaphysics of theology without obscuring the subject, or dimming its sanctity. Some idea of what he was as a preacher may be had from the volume of sermons he published on some of the most abstruse topics in Divinity; and a specimen of his taste and judgment in the metaphysics of literature is exhibited in some beautiful but fragmentary dissertations published several years since in the Dublin Journal of Science. As a writer our President has not left much; the elementary but admirable works alluded to, the essays and sermons, I believe, comprise the whole; his business was not so much to advance science himself as to stimulate and direct others; not to press forward in his own person, leaving the path in darkness, but to hold high the torch for the young aspirant,—to mark the road. It is, however, an interesting fact, that he has left a large collection of manuscripts behind, the natural result of a well-stored, active, and inventive mind, and it is not to be doubted but that our fellow academic and Vice-President, the heir of his name and of his talents, will not suffer a grain of his father's gold to be lost.

In one other point of view might our President be contemplated, but it is unnecessary. He could be spoken of as the gentleman and the Christian, as one whose character impressed the respect, which his manners associated with affection; as one whose gentleness, urbanity, and good feeling converted every one that approached him into a friend, and rendered the intercouse of official duty a privilege and a pleasure. Our President's manners were benevolent, because his mind was essentially so; because he anticipated and provided for the feelings of every one with whom he had intercourse both on great and small subjects; because, incapable of feeling jealousy or envy, he was always desirous of bringing every individual fully and entirely forward, and as there never was one who lived more for others and less for himself, so there never has been one who manifested such a characteristic more decidedly in his manner and deportment. But it is unnecessary to proceed—more would on this topic be unnecessary to those who in public and in private have witnessed or have experienced the influence I have mentioned; and enough has been said, however feebly, to meet in some degree the wishes of the Academy, its sense of justice, of gratitude, and of affection; that one who shared so materially in the first triumphs of abstract science in this country should not pass off the stage unnoticed and unlamented in this room, dedicated to the pursuit of that science and that literature which he loved,—that one with whom every advance of science in Ireland will by impartial posterity be associated, should from us, his contemporaries, receive some meed of his renown, and that while our kindred institution, the University, is endeavouring to connect his name imperishably with the exertions and the rewards of the aspirants after scientific fame, we who enjoyed his intercourse and can claim his latest recollections, should add too our mourning tribute of applause to hang upon his bier.

THE

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(List corrected to April 16, 1838.)

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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1838. No. 9.

January 22.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

A LETTER from Colonel Yorke was read, enclosing a copy of Lord John Russell's letter to the Lord Lieutenant, informing his Excellency that the Academy's address to the Queen was very graciously received, and that her Majesty has been pleased to consent to become the Patroness of the Academy.

Sir William Betham read a paper on the "Eugubian Inscriptions" preserved at Gubbio, an Episcopal city in the Papal states, on seven plates of bronze, which were discovered on excavating the crypt of an ancient temple there in the year 1444. Five of the inscriptions are in the old Etruscan character, written from right to left, like the Hebrew and other Shemitic languages; two, the sixth and seventh, are in what is now called the Roman character, written from left to right. Two other plates were found at the same time, and were sent to Venice in the year 1505, but never returned.

The object of Sir William Betham's paper was to show that the ancient Etruscan language was identical with the Iberno-Celtic, and, that the Irish language, as it is still spoken in this country, affords the true clue to the interpre-

tation of these inscriptions, which have baffled the efforts of so many learned men.

The author read to the Academy his translation of the sixth and seventh tables, (those written in the Roman character), which he selected as containing matter of great interest to the inhabitants of these countries, being a record of the discovery of the use of the magnetic needle in navigation, and of the British Islands, by the ancient Etruscans.

The following is an abstract of the facts recorded in these very ancient documents, according to Sir William Betham's translation of them:

The sixth table commences with an invitation to the people, to go "*to divide and farm the western lands,*" and to proceed to the west, "*where are three islands*" of rich and productive soil, with cattle and sheep in abundance, and *large black deer*, productive of mines, with fine streams and every advantage for residence. It then proceeds to state, that the ships which were fitted out to convey settlers had been provided with stored food and abundant provisions for the voyage, with good water *in skins* to be served out daily; that the skill and seamanship of the commanders and the men guaranteed their safety; and that the people might venture to go, with the most perfect confidence, over the '*for ages untracked wilderness of the sea.*' Then is depicted the wretched system of coasting navigation, which confined the trader to the shores, amidst shoals, rocks, surfs, and other imminent dangers, all which had been overcome and avoided by the discovery of the *little pointer*, (the PIAC LU), by which they were enabled to cross from coast to coast in '*the same certain and established track*;' and the high seas, which the mariner formerly contemplated with the greatest apprehension when out of sight of land, might be crossed with certainty, avoiding all dangers in deep water. "*It was become trade's plain, a noble space, an easy space, a shortened space, tracked space, man's own space, the means of trade's*

progress, man's treasury, the source of the increase of man's wealth. Navigation by stored food and the LITTLE POINTER *was made safe and pleasant.*"

This passage occurs several times in the inscription. The *little pointer* and *the stored food* are described as the means by which the three western islands had been discovered.

The events of former voyages are described very emphatically: on one occasion, it appears, the ships had gone so far north that the water skins had been frozen and burst, and they fell in with what they supposed to be land, but found, on examination, to their great consternation it was only ice.

They proceeded with cautious anxiety by means of the sun by day and *the seven* (ꞅeacὸ ꞃe, *ursa major*) by night; and at length saw the land of the three islands; on *the first* of which they saw sheep.

The concluding passage of the seventh table reminds the *Phœnicians*, (for although these people were certainly *resident in Italy*, they are throughout called PUNI), that the island country which had been discovered would form a noble country for trade, protected from hostile aggression by the sea; and might hereafter become an asylum (in case their own country should be invaded and conquered by an enemy of *robbing people*) to which they might retire in their ships, and where their friends and colonists would receive them with joy and gratitude in return for the benefits they had conferred upon them.

In the last paragraph we are informed that the inscription was written *after three hundred years from the great subterraneous noise and commotion, or the earthquake.*

Of the former unsuccessful attempts to decipher these very interesting inscriptions, Sir William Betham referred to that of Father Gori, published with a *fac simile*, and that

of Lanzi, in his *Saggio di Lingua Etrusca*, both of which, he stated, were unsatisfactory, far-fetched, and absurd.

Mr. Samuel Ferguson read the first part of a paper "on the Antiquity of the *Kiliee*, or *Boomerang*," the object of which was to show, that the peculiar characteristics of that instrument belonged to the *cateia* and *aclys* of the Latin classic writers, the latter being, most probably, identical with the *ancyle* of the Greeks.

The chief proofs in the case of the *cateia* turned, 1st, on the epithet *panda* applied to it by Silius Italicus, (Punic. l. iii. v. 278,) and, 2nd, on the description of it given by Isidore, a writer of the end of the sixth and beginning of the seventh century, who states concerning it, "*Si ab artifice mittatur rursùm redit ad eum qui misit.*" (Origin. l. xviii. c. 7.)

The chief proofs in the case of the *aclys*, rested, 1st, on the identification of the *aclys* and *cateia*, by Servius (in Æneid. l. vii. v. 730, 741); 2nd, on an inference of its semilunar shape, drawn from Valerius Flaccus, (Argonaut. l. vi. v. 99); and 3rd, on the statement of Sidonius Appollinaris, a writer of the fifth century, who, referring, as it would appear, to these weapons, describes them as missiles, "quæ feriant *bis* missa *semel*." (Carm. V. v. 402.)

The identity of the *aclys* and *ancyle* was inferred from their apparent etymological relation, and from the statement of the Scholiast on Euripides—*αγκυλαι τα ακοντια, απο του επηγκυλιασθαι*, (Euripid. Orest. v. 1479).

An investigation of the radical meanings of these names confirmed the testimonies adduced, by showing that each was properly descriptive of a curved instrument.

The statement of Isidore, that the *cateia* and club of Hercules were the same, was, in like manner, confirmed by an investigation of the radical meaning of the word *clava*, and by the exhibition of drawings of curved *clavæ* (almost identi-

cal in form with a variety of the Australian instrument) taken from the antique, one of which appeared to have been intended to represent the Herculean weapon. A further confirmation was drawn from the fact, that instruments, formed on the model of these, were found to exhibit the peculiar flight of the boomerang. So also of the club or hammer of Thor, the Hercules of Scandinavian mythology, stated in the Edda to have possessed similar properties; instruments of a +, and hammer shape, being also found to exhibit all the peculiarities of the Australian weapon. Hence, an illustration of the crosses on Pagan British coins, and of the tradition of cruciform missiles still preserved in Irish romances.

The connexion between the curved club and the boomerang being thus established, it was suggested, that some relationship might be looked for between the Germanic nations, who still call their club *keile* and *kiele*, a name properly descriptive of a crooked weapon, and the Australian tribes who call the cognate instrument *kiliee*.

From the remarkable fact, that the names of the straight spear in several of the languages of Europe are either identical, or radically connected, with these characteristic names of the crooked missile, it was argued that the boomerang is a more ancient weapon than the spear.

DONATIONS.

Astronomical Observations made at the Observatory of Cambridge. By the Rev. James Challis, M. A. Vol. IX., for the year 1836. Presented by the Author.

Address of His Royal Highness the Duke of Sussex, K. G., &c. &c. &c., the President, read at the Anniversary Meeting of the Royal Society on Thursday, November 30th, 1837. Presented by the Society.

Guilielmi Gilberti, de Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure; Physiologia nova, plu-

rimis et argumentis, et Experimentis demonstrata. Fol. Lond. 1600. Presented by Aquilla Smith, M. D.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles. Tom. X. Presented by the Royal Academy of Brussels.

Mémoires Couronnés par l'Académie Royale des Sciences et Belles-Lettres de Bruxelles. Tom. XI. Presented by the same.

Bulletin de l'Academie Royale des Sciences et Belles-Lettres de Bruxelles, 1837. Nos. 1 to 9. Presented by the same.

Programme des Questions proposées pour le Concours de 1838, *par l'Académie Royale des Sciences et Belles-Lettres de Bruxelles.* 3 copies. Presented by the same.

Annales de l'Observatoire de Bruxelles, publieés aux frais de l'Etat. Par le directeur, A. Quetelet. Tom. I. Deuxième Partie. Presented by the Author.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. Deuxieme Semestre, 1837. Nos. 1 to 26. Presented by the Academy.

February 12.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The following gentlemen were elected Members of the Academy:

John Anster, LL. D., Joseph Carson, Esq., F. T. C., Mountiford Longfield, LL. D., Robert Caldwell, Esq., Alexander Boyle, Esq., Thomas Drummond, Esq., John Hamilton, Esq., Rev. George Vernon, Rev. Robert Knox, James Whiteside, Esq.

Mr. S. Ferguson read the continuation of his paper on the Antiquity of the "Boomerang." The author exhibited a tabular digest of the significant synonymes of a variety of words, all of them necessarily involving the idea of curvature. These he arranged according to their palpable resemblances; and gave it as his opinion, that the *indices* or characteristic syllables of the classes so resulting were uniformly identical with the roots of the names by which the curved weapon and spear have been known.

Mr. Ferguson stated, that the transit of these names from the one class of weapons to the other, appears to have taken place through the medium of the *amentum*, or attached sling, by which the spear was originally thrown. He suggested a similar mode of throwing the Australian instrument, and illustrated it from a British coin of Cunobeline.

From an investigation of the relations observable among the nations which appear to have used weapons of this description, the author concluded that the use of them in Europe was in great measure peculiar to the Gomarite branch of the Japetian family.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciénces. Premier Semestre, 1838. Nos. 1, 2, 3, and *Tables Alphabetiques.* Jan.—Jun. 1837. Presented by the Academy.

The Phrenological Journal and Magazine of Moral Science. Vol. XI. No. 44. New Series, No. 1. Presented by the Phrenological Society.

Ordnance Survey of the County of Londonderry. Colonel Colby, R. E., F. R. S. L. and E., M. R. I. A., Superintendant. Volume the First. 4to. Presented by his Excellency the Lord Lieutenant.

The Ordnance Maps of the Counties of Sligo, in 49 *sheets:*

and Longford in 29 sheets: each including the Title and Index. Presented by His Excellency the Lord Lieutenant.

Flora Batava. 4to, Amst. 1836. Nos. 110, 111. By Jan Koops and H. C. Van Hall. Presented by the Authors.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1838. No. 10.

February 26.

SIR WM. R. HAMILTON, A.M., President, in the Chair.

THE Rev. Dr. MAC DONNELL, Secretary of Council, gave notice that it was his intention to resign his Office of Secretary, and place in the Council.

A letter was read from Dr. Ferguson, resigning his place in the Council.

The recommendation of Council to repeal the latter part of Chap. VIII. sect. 4, of the Statutes of the Academy, from the words "except by a vote," to the end, was agreed to.

The Rev. J. H. Todd exhibited the original of a Charter granted to the Abbey of Mellifont, near Drogheda, in the county Louth, by John, son of Henry II., afterwards king of England. The charter was given at Castleknock, but the year is not specified. It must, however, have been the year 1185, when John, by confirmation of Pope Urban VIII. was appointed by his father, Lord of Ireland, (*Hoved.* fol. 359. d.) whither he accordingly went soon after, accompanied by 400 knights, some archers, and many clerks, (*clerici plures,*) one of whom was Giraldus Cambrensis, who tells us of himself that he was *specialius a patre cum filio directus*, (*Gir. Cambr.* cap. 31, *Hoved.* fol. 360.) John was not quite a year altogether in Ireland, having been compelled to abandon the

country in consequence of the offence he gave to the chieftains of the Pale. The date of the charter is therefore sufficiently ascertained; in it John assumes the title of *Dominus Hiberniæ*, the same which was adopted before by his father, and held by all the kings of England since that period to Henry VIII. But it is remarkable that he lays claim to the exercise of an independent sovereignty; the object of the charter being to *confirm* a previous charter granted by the king of England. Archdall appears to have seen this charter, but has given an imperfect and very inaccurate copy of it, (*Monast. Hib.* p. 480.)

Mr. Todd also read a letter from Col. Currey of Lismore Castle, consenting to lend the Academy the ancient MS. found in 1811, buried under the ruins of the Castle. The MS., according to Mr. O'Reilly, was written in the latter end of the 15th century; the writing is exactly similar to that of the Book of Fermoy, written in 1487, and both volumes were probably the work of the same scribe. The Book of Lismore contains poems and historical treatises relating to the M'Carthys,—lives of saints,—the wars of Callaghan of Cashel,—the adventures of Teige Mac Cein, and the battle of Druim-damhghoire; also a very valuable tract giving an account of the battle of Gabhra.

The thanks of the Academy were voted to Colonel Currey.

Professor Lloyd, V.P. read the following communication, contained in a letter from M. Abbadie, detailing the principal results of his scientific expedition to the Brazils. The letter is dated the 31st of August, 1837; and Mr. Lloyd regretted that he had no earlier opportunity of laying it before the Academy.

"I availed myself of the departure of a young friend for Ireland to write to you before my departure for the Brazils, announcing the purport of my voyage, and sending at the same time a copy of my remarks on the Euskara language,

which I offered to the Royal Irish Academy. I should be glad to learn that it has proved acceptable, however trifling.

"As I have always remarked that scientific discoveries are long known either in Ireland or in France, before they travel from one country to the other, I think it may be gratifying to you to become acquainted with a few particulars of my voyage.

"We made three observations every hour, day and night, from the 11th of February to the end of March. The instruments examined were, 1st, the horizontal magnetic needle; 2nd, the thermometer; 3rd, the barometer, *à niveau constant;* 4th, Saussure's hair hygrometer. The direction and force of the wind, state of sky, &c. were also observed.

"The variations of the needle were far greater than in Paris; the hours of maxima and minima agreeing very well together, except near the time of the sun's passage through the zenith of Olinda, (lat. 8°. 0′. 58″. long. 2^h 19^m W.) I then remarked two important phenomena; 1st, the extreme digressions, A. M. in one sense, became P. M. in the same direction, when the sun began to culminate in the other hemisphere, after passing through the zenith. 2ndly, this remarkable alteration was preceded by *sudden* and *permanent* changes in the variation of the needle, amounting to more than one degree. The first of these variations took place twelve hours after the sun's centre had reached a declination equal to the latitude of the place. All these sudden changes were accompanied with feeble storms confined to one small part of the horizon. Referring to the problem as laid down in the *Annuaire du Bureau des Longitudes* for last year, it would seem that the transition from the daily variations belonging to the northern hemisphere to those which characterize the southern part of our globe, is not on the magnetic equator, but depends on the sun's path in the heavens; and the sun acts here not as a source of

heat, according to Captain Duperrey's supposition, but as a source or centre of magnetic attraction, if I may dare say so in the present uncertain state of science.

"The mean results of the observations made by us on magnetic intensity of forces, confirm very nearly the ratio between the equator and our latitudes, as first given by our distinguished countryman Captain Sabine. The dip was 13°. 9′. but varied a little under the sun's influence.

"The maxima and minima of the barometer's range, confirmed partly M. Boussingalt's results.

"The mean temperature of the place, as given, 1st, by the daily observation of the thermometer; 2nd, the heat of springs; and 3rd, that of the ground at small depths, was 27.5 *grades;* nevertheless, the bottom of an Artesian well, 200 feet deep, was 24.0 grades, being much *colder* than at the surface. This was measured three times, as it seemed contrary to our received theories on a geocentric focus of heat.

"M. Selligue of Paris, has succeeded in making a folding iron barometer, which has been observed every day after a thorough shaking. It has not altered its primitive error of .001 metre. I confess that I am rather sanguine about this instrument, which I shall carry with me to Egypt and beyond the Red Sea."

M. Abbadie is at present in Abyssinia, whence he will proceed along the shores of the Red Sea.

Professor Lloyd communicated to the Academy the results of his observations on the diurnal march of the horizontal needle, made on the 31st of August and 13th of November, 1837.

These observations having been made with the apparatus of Professor Gauss, Mr. Lloyd commenced by describing the construction and uses of that apparatus, the principal parts of which he exhibited to the Academy. He then ex-

plained the system of combined observation carried on under the auspices of that distinguished geometer, at so many places in Europe, and now, through the instrumentality of the Russian government, extended over the whole of northern Asia, and reaching even unto China. The results of this system hitherto obtained are, 1st, that the direction of the terrestrial magnetic force (estimated in the horizontal plane) is subject not only to a regular diurnal change, whose maxima and minima return at fixed hours; but also to *irregular perturbations*, which succeed one another with great rapidity, and which are not periodic. 2ndly. That these irregular movements of the horizontal needle occur at the same instants of *absolute* time, and are similar to one another, at the most distant places at which observations have been hitherto made. This synchronism in the movements of the needle, Mr. Lloyd observed, was so exact, that with the instrumental means now placed at the disposal of observers by M. Gauss, he had no doubt but that a very close approximation might be made to the determination of geographical longitudes.

Professor Lloyd then proceeded to lay before the Academy the results of the observations made in Dublin according to the methods described. The first series of such observations was made every five minutes during the twenty-four hours, commencing at noon (Gottingen time) on the 31st of August last. The observations were undertaken in compliance with the general invitation of Baron Humboldt, and on the occasion of the scientific expedition of M. Parrot to the North Cape. The results are laid down in curves, according to the usual method of graphical representation, and exhibit a remarkable disturbance occurring between 8 and 11 P. M. (Gottingen time). The observations made at the same time elsewhere are not yet published; but Mr. Lloyd has, through the kindness of Baron Humboldt, received a copy of the observations made at Berlin at the

same hours, under the superintendance of M. Encke, and the agreement is very remarkable.

The second series of observations was made every five minutes during the twenty-four hours, commencing at noon (Gottingen time) on the 13th of November last. These observations were undertaken at the request of Baron Humboldt, and with the view of ascertaining whether there existed any connexion between these perturbations of the needle, and the meteoric displays, which have been supposed to recur at that period in unusual frequency. The observations do not exhibit any very marked magnetic phenomenon; but on the following evening (November 14th) the needle was disturbed in a most unusual manner. It oscillated in very large arcs, and the maxima and minima of mean position succeeded one another with great rapidity. The whole range of the disturbance amounted to 1°. 20′.

The nights of the 12th, 13th, and 14th of November were cloudy in Dublin, and no meteors were observed.

Mr. Petrie gave an account of a very remarkable collection of stone circles, cairns, &c. situate in the townland of Carrowmore, in the parish of Kilmacowen, and about two miles from the town of Sligo. They are of the class popularly called Druidical Temples, and have, in every instance, one or more Cromlech or Kistvaen within them. In some instances the circle consists of a single range of stones, in others of two concentric ranges, and in a few instances of three such ranges; and nearly the whole are clustered together in an irregularly circular manner, around a great *cairn*, or conical heap of stones, which forms the centre of the group. The circles vary much in diameter, number, and height of stones, and other particulars; and the Cromlechs also are of various sizes and forms. Many of these monuments are greatly dilapidated; but there are still existing vestiges of about sixty circles with Cromlechs, and as it is

known that a vast number has been totally destroyed by the peasantry, there is reason to believe that the collection could not have been originally much less than double that number. They are all formed of granite bolders, except the covering stone and another of the Cromlech in the great cairn, which are of lime stone.

In all the circles, which have been either wholly or in part destroyed, human bones, earthen urns, &c. have been invariably found; and one circular enclosure, outside the group, and of far greater extent than any of the others, but evidently of cotemporaneous construction, is filled with bones of men and animals.

Mr. Petrie stated, that this is the largest collection of monuments of the kind in the British islands, and probably, with the exception of the monuments at Carnach in Brittany, the most remarkable in the world.

From the design observable in their arrangement and uniformity of construction, he considers them all of cotemporaneous age; and from the human remains found in all of them, he concludes that they are wholly of sepulchral origin, and erected as monuments to men of various degrees of rank slain in a battle, the great central cairn being the sepulchre of the chief, and the great enclosure outside the group, the burial place of the inferior class. Such monuments, he stated, are found on all the battle fields recorded in Irish history, as the scenes of contest between the Belgian or Firvolg and the Tuatha de Danann colonies, and he considers these monuments to be the tombs of the Belgians, who, after their defeat in the battle of the Southern Moy-Turey, had retreated to Cuil-Iorra, and were there again defeated, and their king, Eochy, slain in crossing the strand of Ballysadare Bay, on which a cairn, rising above high water, still marks the spot on which he fell.

As monuments of this class are found not only in most countries of Europe, but also in the East, Mr. Petrie thinks

their investigation will form an important accessary to the history of the Indo-European race, and also that such an investigation will probably destroy the popular theories of their having been temples and altars of the Druids.

March 16. (Stated Meeting.)

SIR WM. R. HAMILTON, A. M., President, in the Chair.

This being the day appointed by Charter for the annual election, the following Officers and Members of Council were chosen for the ensuing year:

President—Professor Sir Wm. Rowan Hamilton, A. M.
Treasurer—Thomas Herbert Orpen, M. D.
Secretary—Joseph Henderson Singer, D.D.
Secretary to Council—Rev. Humphrey Lloyd, A. M.
Secretary of Foreign Correspondence—Sir Wm. Betham.
Librarian—Rev. William Hamilton Drummond.

Committee of Science.

Rev. Franc Sadleir, D. D. Provost of Trinity College; Rev. Humphrey Lloyd, A.M.; James Apjohn, M. D.; James Mac Cullagh, Esq. A. M.; William Stokes, M. D.; Rev. William Digby Sadleir, A.M.; Robert Ball, Esq.

Committee of Polite Literature.

His Grace the Archbishop of Dublin; Rev. Joseph H. Singer, D. D.; Andrew Carmichael, Esq.; Samuel Litton, M. D.; Rev. William H. Drummond; Rev. Charles Richard Elrington, D. D.; Rev. Charles William Wall, D. D.

Committee of Antiquities.

Thomas Herbert Orpen, M. D.; Sir William Betham; George Petrie, Esq.; Rev. Cæsar Otway, A. B.; the Very

Rev. the Dean of St. Patrick's; Rev. James Henthorn Todd B. D.; Henry J. Monck Mason, Esq. LL. D.

The President under his hand and seal appointed the following Vice-Presidents:

His Grace the Archbishop of Dublin; The Provost; Samuel Litton, M. D.; Rev. Humphrey Lloyd.

The Committee appointed to examine the Treasurer's Accounts reported as follows:

"Examined the above Account,* with the vouchers produced, and found it to be correct; and we find that there is a balance in bank of £229 2*s*. 5*d*.; and in the Treasurer's hands £178 16*s*. 11*d*., making a total balance of £407 19*s*. 4*d*. sterling.

"(Signed,)

"Franc Sadleir,

"Samuel Litton."

"*Feb.* 19*th*, 1838."

"The Treasurer reports that there are the following portions of Stock in the Bank of Ireland to the credit of the Academy:

"£1500 in 3 per Cent. Consols.

"£1500 in 3½ per Cent. Government Stock, being the Cunningham Fund.

"(Signed,)

"Franc Sadleir.

"Samuel Litton.

"*Dec.* 31, 1837."

The Dean of St. Patrick's read a paper giving an account of the Medals and Medallists connected with Ireland, from the period of Charles the Second (when the first medal was struck that had any reference to that kingdom) to the pre-

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* Entered in the Treasurer's Book.

sent time. They were classed according to the different reigns, and the events which they recorded were noticed. Some biographical memoirs of the Mossops, father and son, were also introduced; individuals of whom but little is known, even in Dublin, their native city, beyond those works which have long been admired as worthy of the best days of the medallic art.

Mr. Todd, for Mr. Petrie, read a paper by the late Dr. West, "on the Ancient Geography of Gaul and the British Isles." The principal object of this paper is to ascertain whether the Belgæ were of Teutonic or Celtic origin, and whether they spoke a Gaelic, or Irish, or a Cumric or Welch dialect of the Celtic; the author inclined to the opinion that they were of Celtic origin, and spoke a dialect of the Cumric, more resembling the Cornish than the Welsh, but different from the Erse or Gaelic; he brought many curious and valuable facts to support his theory.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Nos. 4, 5, 6, 7, 8, for the year 1838. *Avec Tables Alphabetiques.* Presented by the Institute.

Transactions of the Cambridge Philosophical Society. Vol. VI. Part 2. Presented by the Society.

Flora Batava. By Jan Koops and H. C. Van Hall. Nos. 112 and 113. Presented by the Authors.

Philosophical Transactions of the Royal Society of London. For the year 1837. Parts 1 and 2. Presented by the Society.

List of the Fellows of the Royal Society. November 30, 1837. Presented by the same.

Address of his Royal Highness the President of the Royal Society, held at the Anniversary Meeting, November 30th, 1837. Presented by the same.

Abstracts of the Papers printed in the Philosophical

Transactions of the Royal Society of London, from 1830 *to* 1837, *inclusive.* Vol. III. 1830 to 1837. Presented by the same.

Proceedings of the Royal Society of London. Nos. 28, 29, 30. Presented by the same.

Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 8. Presented by the Society.

Essays on Unexplained Phenomena. By Graham Hutchinson. Presented by the Author.

On the Functions of the Cerebellum, by Drs. Gall, Vimont, and Broussais. Translated from the French by George Combe. Also, *Answers to the Objections urged against Phrenology by Drs. Roget, Rudolphi, Prichard, and Tiedemann.* By George Combe and Dr. A. Combe. 8vo. Edinburgh, 1838. Presented by George Combe, Esq.

Bulletin de la Société Geologique de France. Tom. IX. Feuilles 1—5, 1837 à 1838. Presented by the Society.

March 26. (Adjourned Meeting.)

SIR WM. R. HAMILTON, A. M., President, in the Chair.

A paper, by Mr. Carroll, on the Motion of the Boomerang, was read. In this paper the author seeks to explain the properties of the flight of the weapon by assimilating the effect of the air's resistance on it to that exerted upon a flat circular disc.

Professor Lloyd, V. P. made a few observations upon the same subject, in which he endeavoured to show that the peculiar movement of this projectile was but an extreme case of acknowledged laws. When a body moves in a resisting medium, and when the resultant of all the forces of resistance, which act upon the several portions of its surface, is not contained in the vertical plane of projection, the body must deviate from that plane. This is generally the case in

the motion of a body in a resisting medium. This effect of the air's resistance can be shown to be unusually great in the case of a body (like the boomerang) composed of two straight arms united at a large angle, and projected with a revolving motion; and hence the large resulting deviation in this case, amounting (as is known) to 180°. Mr. Lloyd observed, however, that this anomalous deviation was by no means peculiar to a projectile of this form; and that there were even other shapes which exhibited the property in a more remarkable manner.

The other peculiarity in the flight of the boomerang, namely, its alternating ascents and descents, were ascribed by Mr. Lloyd to a *nutation* in the axis of revolution; the instrument (on account of its flat shape) being compelled to move in its own plane, which is also the plane of rotation. The motions of *translation* and of *rotation* of a heavy body in a *resisting medium* are not independent of one another, as they are *in vacuo;* and hence the variations of the progressive movement will produce corresponding variations both in the velocity and direction of the rotation.

Professor Lloyd read a letter from Mr. Knox, detailing some results of the performance of his rain-guage, during the months of August, September, and October, and describing a mode in which these results were *graphically* registered. The following is an extract:

" Drawing from a centre eight lines, to correspond with the cardinal and intermediate points, I take on each line a space respectively proportional to the amount of rain that has fallen from that point during any month; connecting the point so taken, I get a curve (or rather an eight-sided figure) which exhibits at one view both the amount and character of the rain during the month. It also enables the observer to compare one month with another, and likewise to get a mean curve for the season, which may be of great use in determining local climate. It is probable that the

urve for the three winter months may have the same er, if not the same magnitude, during different years. ıe for August, for example, has shot down far to the which was owing to a few violent thunder storms hat direction. The curves for September and October gone more to the west; and it is probable that in g I shall find the curve extending more to the easterly f the compass, as our then prevailing winds are from uarter.

Another important thing with regard to climate may be ıed by using this guage in conjunction with Whewell's meter; for by drawing in the same manner and on me paper, the *amount* of wind from each of the eight s for any month, we may see at once the comparative ss or wetness of any wind, (I mean with regard to *rain*, ıpour,) which the mere amount of rain from the dif- directions would not give."

ıe following table exhibits the amount of rain during ree months above mentioned:

	August.	September.	October.
S.	0.342	0.862	0.042
S. W.	1.434	1.226	0.836
W.	0.214	0.954	1.021
N. W.	0.052	0.572	0.251
N.	0.199	0.515	0.148
N. E.	0.050	0.248	0.016
E.	0.026	0.065	0.003
S. E.	0.080	0.195	0.019
Total	2.397	4.637	2.336

. paper was read "on some Snow Crystals observed on 4th of January, 1838," by William Thompson and rt Patterson, Esquires.

he crystals, which form the subject of this paper, were ved by the authors among the ordinary snow-flakes, in

a shower which fell at Belfast on the 14th of January; the crystals appearing to constitute fully one-third of the snow that fell. Nineteen distinct forms were observed, and are described in detail in the paper. Most of them are identical with those delineated by Hooke, Nettis, and Scoresby; there are some, however, which do not appear to have been before observed. They all belonged to the "lamellar," or first of the genera into which they are divided by Scoresby. The size of the crystals generally exceeded considerably that of those observed by the above-mentioned authors; their average diameter being such that the naked eye could readily discriminate the various figures, as they lay on a dark ground.

From the great variety of figures observed in the course of a very limited time (a single hour) it is inferred by the authors, in opposition to the opinion of Scoresby, that a considerable range of temperature is not essential to the production of very various forms.

The weather for some days previous had been frosty, and the barometer gradually falling from about noon on the 12th. On the morning succeeding the day in which the observations were made, there was snow, succeeded by showers of sleet; and at noon a heavy rain set in, and continued without intermission the remainder of the day.

The President, in presenting the copy of the Arenarius of Archimedes, described in the donations of this evening, stated that he had intended to offer some remarks on that relic of mathematical antiquity; but announced that he considered it unnecessary to do so, on finding that his remarks had been, to a great extent, anticipated by Professor Rigaud of Oxford.

Professor Lloyd communicated the results of a paper "on the Annual Decrease of the Dip in Dublin."

It is well known that the dip has been diminishing in

Europe from the time of the earliest observations, and that the rate of this diminution is not uniform. It is, accordingly, a question of considerable interest and importance to determine the precise amount of the annual decrease, for a given epoch, at any station. Conceiving that the observations of dip in Dublin, though extending over a very limited time (three years), were yet sufficiently numerous to furnish a close approximation to this amount, the author has put them together with that view. The observations are thrown into five distinct groups, those of the same group having been made nearly at the same time. The following are the results:

	Date.	No. of Obs.	Dip.
I.	Oct. 21, 1833,	1	71°. 9′. 1.
II.	Sept. 9, 1834,	10	71°. 7′. 1.
III.	Sept. 18, 1835,	16	71°. 5′. 2.
IV.	April 25, 1836,	8	71°. 3′. 9.
V.	Aug. 5, 1836,	4	71°. 1′. 7.

The observations of M. Kupffer clearly show, that the diminution of the dip is not uniform throughout the year; but that from December to May it is nearly stationary, the whole diminution taking place in the remaining eight months. For the convenience of calculation, we shall assume that the diminution takes place at a uniform rate throughout these eight months. It is evident then, that if δ denote the *unknown* dip at an *assumed epoch*, the 1st of January, 1836; $\delta_{\prime}$ the dip *observed* at any other time; n the number of *effective* months in the interval; and ϵ, the *monthly decrease*, each of the above results will furnish an equation of condition of the form

$$\delta + n\epsilon = \delta_{\prime}$$

Combining these five equations by the method of least squares, we obtain two resulting equations which give the most probable values of δ and ϵ. We thus find,

$$\delta = 71°. 3'.84, \qquad \epsilon = 0'.97.$$

Hence the *annual decrease* of the dip in Dublin (or $\delta\epsilon$) is $2'.38$.

The close agreement of this result with that recently deduced by Major Sabine, from his observations at the Regent's Park, is very remarkable. From these observations it appears that the dip has undergone a diminution of 39′ at London, in the interval between August 1821, and November 1837, an interval of 16¼ years. The annual decrease, therefore, is 2′.40.

Resolved, on recommendation of the Council,—" That as a first step towards the attainment of greater regularity of payment by members in future, the five following defaulters, being deeply in arrear, be now excluded from the Academy, and declared to be no longer members thereof; but, as a measure of indulgence, that they be not sued at law for their arrears:

		£	*s.*	*d.*
Henry Grattan Douglas, M. D.,	*in arrear,*	37	16	0
Thomas Little, M. D. . .	——	37	16	0
John L. Arabin, Esq. .	——	33	12	0
Gerard Macklin, Esq. . .	——	27	6	0
William Shaw Mason, Esq. .	——	23	2	0"

Resolved,—" That the portion of the By-law, Chapter VIII. Section 4, which forbids the commencement of a new paper after 10 o'clock, be suspended for the present."

DONATIONS.

Hortus Mauritianus. Par W. Bojer. 8°. Maurice, 1837. Presented by Lord Glenelg.

Transactions of the Geological Society of London. Second Series, Vol. V. Part the First. Presented by the Society.

The Greek Text of the Arenarius of Archimedes, believed to have been edited by Dr. Moor of Glasgow. Presented, through the President, by Professor Russell of Edinburgh.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1838. No. 11.

April 9.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The following gentlemen were elected members of the Academy.

Simeon Hardy, Esq., Robert Adams, Esq., Captain John Pitt Kennedy, George Digges Latouche, Esq., Jacob Owens, Esq., Charles T. Webber, Esq., Henry Barry, Esq., The Hon. James King, Elliot Warburton, Esq., George Downes, Esq., The Venerable the Archdeacon of Raphoe.

Sir William Betham read a letter from Dr. Hibbert Ware, describing a cromlech near Bombay, in India. The following are extraets :—

"My chief motive for sending you two sketches of cromlechs, recently discovered by my son, Mr. William Hibbert Ware, Assistant Surgeon, 2nd Foot, or Queen's Royal, in the East Indies, has a reference as much to the interest which such a distant locality attaches to this very early species of monument, as to the apparent usé to which it is alleged to have been subservient.

"In the admirable history of Ireland by Mr. Thomas Moore, this interesting writer, while treating of cromlechs, has adverted to the remarkable circumstance recorded in Maundrel's Travels, that a monument of this description was

found situated upon the Syrian coast, in the very region of the Phœnicians themselves. He also alludes to the cromlechs which are affirmed, on the authority of Sir Richard Colt Hoare, to have been discovered so far east as Malabar. I have not the means at present of consulting this last mentioned author's History of Ancient Wiltshire, where the account appears, but, happily, the drawings are copied into the work of your late friend Mr. Godfrey Higgins, in his 'Celtic Druids,' who states, that 'it is remarkable Sir Richard Hoare did not accompany the sketches with any observations;' but he properly adds, that 'this author's character is too well known to admit a suspicion of their genuineness. To this remark I heartily subscribe, and if any doubt could ever have existed on the subject, (of which I am not aware,) it must be removed by the communication which I now send you, being an extract of a letter, with drawings, from my son, Mr. William Hibbert Ware, relative to cromlechs discovered by him near Belgaum. The information is to the following effect:

"'I enclose you two sketches of remains which very much resemble the cromlech of Kits Coty House in Kent. These I accidentally stumbled upon in the course of a tiger hunt. Into the composition of each of these monuments four stones enter, which incline towards one another, and are surmounted by one large horizontal stone. From an inquiry of the natives, including information which I received upon the spot, I learn that these remains are tombs of ancient date; and hence, from analogy, equally reasonable with a supposition entertained on the round towers of Ireland, it is probable that such piles in England were erected more as sepulchral stones than for other uses. It is affirmed, that the present structures were never raised for religious purposes. The height of the pile, shewn in sketch fig. 1, is eight feet, the other dimensions being proportionally represented; and this estimation applies also to sketch fig. 2. Their composition is greenstone.'

I.

II.

"Such is the information I have received relative to this very remote locality assignable to the cromlech. Into any theory of European and oriental intercourse which the fact may suggest, I have no wish at present to enter.

"It is remarkable that the accounts given of these Indian monuments, tend to a conclusion similar to that which is

derived from the information you were so kind as to send r relative to a cromlech being found within a sepulchral ca at Phœnix Park, namely, that it was used for purposes interment. But the question is, if such a conclusion adı of an universal application? The cromlech has been fou in the north of Europe, placed on the very summit of a pulchral cairn, as Sjöborg, in his systematic work, l pointed out, and in this case, it appears more like an oc sional appendix to the cairn, destined, from its pecul structure, to the celebration of sacrifices in honour of t dead. I am satisfied however, that the cromlech origin ly subsisted most frequently independently of any ca whatever; and if, in this isolated state, human ashes ha occasionally been discovered in connexion with it, other stances might be cited, in which very careful excavatic have not afforded any evidence that this monument had a pulchral use. A safer conclusion, therefore, remains, tl the cromlech was most frequently connected with purpo of interment, although not necessarily so; and that in ge ral it was raised for sacrificial objects."

Dr. Kane read a paper on the sulphates and nitrates mercury, particularly the basic salts formed by ammonia.

In a former paper Dr. Kane had shewn, that by the tion of ammonia on the chlorides of mercury, there we generated compounds involving the radical NH_2, (amidoge and the design of the present paper was to develope t function of the ammoniacal element of the oxygen salts of th metal. It was found, however, that from the diversity of t results of former chemists regarding the common basic sa of mercury, it became necessary to re-examine them in ord to establish some fixed points to which the constitution the ammoniacal bodies might be referred.

Among the numerous formulæ which have been assign to Turbith mineral, Dr. Kane has found $Hg\,O.\,SO_3 + 2H$

to be correct, ($Hg = 101,4$,) and there is no other subsulphate; the pure turbith, no matter how prepared, possessing that constitution. By the action of ammonia on persulphate, or on turbith mineral, there is generated a white powder, which was submitted to most careful analysis, and gave the formula $Hgo.so_3 + 2Hgo + Hg.NH_2$. was found. The proof that the fourth atom of mercury in this body is not an oxide, is full and positive, and hence Dr. Kane no longer retains the parallelism of theories used in his former memoir, as the absence of oxygen may now be considered as fully proved.

The crystallizable nitrate of the red oxide of mercury has been found $NO_5 + 2Hg\,O + 2HO$, as the younger Mitscherslich had stated; and Dr. Kane shows that there are two basic pernitrates, of which the one, yellow, is similar in composition to the basic nitrates of copper and bismuth, that is, $HO.NO_5 + 3Hg\,O$, and the second, of a brick red colour, he is disposed to consider as $NO_5 + 6Hg\,O$, though it was found exceedingly difficult to decide whether the compound did not retain a trace of water.

It is known that for the composition of the white precipitate, which is given by ammonia with pernitrate of mercury, different results had been obtained by Mitscherslich and Soubeiran. These discrepancies have been reconciled by the discovery that there are at least two, perhaps three precipitates, almost identical in colour and properties, produced in this reaction, but which differ remarkably in their chemical constitution. When the solutions are cold, and the ammonia not in excess, the white precipitate has the composition $NH_3.NO_5 + 3Hgo$, the formula obtained by George Mitscherslich, but if the liquor be warmed, it becomes $Hg.O.NO_5 + 2Hgo + HgNH_2$. This modification is evidently that which was analyzed by Soubeiran, for he found one atom of acid, one of ammonia, and four of mercury, which ratio is quite true. It will be at once seen that the former body corresponds to

the yellow basic nitrate, the oxide of hydrogen being replaced by the amide of hydrogen. Thus

$$NH_3 = NH_2.H = Ad H.$$
$$HO.NO_5 + 3Hgo.$$
$$HAd.NO_5 + 3Hgo.$$

This view is remarkably corroborated by the fact, that when a solution of nitrate of ammonia is poured on the yellow basic nitrate, the white powder is formed, while nitric acid is set free. Another remarkable case of combination is shewn by comparing the powder formed by boiling the white precipitate with two of those described in this paper. Thus there are

$$Hg.Cl + 2Hgo + HgAd.$$
$$Hg.SO_4 + 2Hgo + HgAd.$$
$$Hg.NO_6 + 2Hgo + HgAd.$$

To which may be added, the oxychloride

$$Hg.Cl + 2Hgo + Hgo.$$

When the white ammonia subnitrate is boiled with solution of ammonia, it dissolves, and a crystalline substance is deposited of a very interesting nature. Its formula, by analysis, is

$$3\,(NH_4O.NO_5) + 4Hgo,$$

But the circumstances under which it is formed rather indicate for its rational formula the following:

$$(HgNO_6 + 2\,Hgo + HgAd) + 2\,(NH_4O.NO_5) + 2\,HO.$$

George Mitscherslich had already obtained a compound of a similar nature, being

$$NH_3NO_5 + 2\,Hgo = (HgNO_6 + 2\,Hgo + HgAd) + NH_4O.NO_5.$$

Passing to the nitrates of the black oxide of mercury, Professor Kane has verified the analysis of George Mitscherslich, of the two crystallized protonitrates; he then shews that there exists one definite subnitrate of the black oxide,

the yellow powder analyzed by Grouvelle. Dr. Kane finds that this powder always retains an equivalent of water, that its formula is $HO.NO_5 + 2\ Hg_2.O$, and that the grey subnitrates which have heen noticed by some chemists, are impure mixtures of black oxide and the yellow powder. Dr. Kane considers the nitrates of the black oxide of mercury to be thus related:

First crystallized, $= Hg_2.O.NO_5 + 2HO$.
Yellow powder, $= HO.NO_5 \quad + 2Hg._2.O$.

Second crystallized, $= 2\ NO_5 + 3\ Hg._2.O + 3HO$. A double salt.

Great difficulty was found in determining what specimen of Hahneman's mercury should be considered as pure and fit for analysis. Considering that the most important sources of error tend to throw the value of mercury too high, Dr. Kane derives his formula from the lowest number which he obtained by analysis, and these numbers were given always by the blackest and purest looking portions. He finds, on these grounds, for the ammonia subnitrate of the black oxide, the formula $NH_3.NO_5 + 2\ Hg._2.O$. which is related to the water subnitrate in a similar manner to what holds in the corresponding compounds of the red oxide.

Thus, in this paper, two propositions are developed: 1st. Increased evidence of the formation of metallic amides. 2nd. That ammonia as amide of hydrogen is capable of replacing oxide of hydrogen in its various functions in the quicksilver salts.

Professor Apjohn read a paper "on the Properties of a new Voltaic Combination," by Thomas Andrews M.D., Professor of Chemistry in the Belfast Institution.

The object of the author in this paper is to extend the results which he has already obtained on the influence of voltaic circles upon the solution of the metals in nitric acid to the case of concentrated sulphuric acid. When a plate of

zinc is heated to the temperature of 240° cent. in sulphu acid, of the sp. gr. 1.847, it is dissolved with the rapid engagement of a mixture of hydrogen and sulphurous a gas; but when a similar plate, voltaically associated witl platina wire, is introduced into the same acid, its rate of lution is reduced to one-third of the other, no gas appe at the zinc, and sulphurous acid, almost perfectly pure, se rates at the platina wire. Similar effects occur at ot temperatures, but the proportion between the quantity zinc dissolved when alone, and when connected with plati varies with the temperature. A minute investigation is gi of the effect of the distance between the metallic surfa and of their relative extent upon the solution of the zinc, the development of the electrical current; from which appears that, as in common cases, the action on the zinc increased by diminishing the distance between the zinc platina in the liquid, but on the contrary, was diminished increasing the extent of the platina surface. The latter a malous result is carefully examined and explained.

The influence of the contact of platina with the ot metals, resembles, in general, its effect upon zinc, excep the cases of mercury and arsenic, in which the solution d not appear to be retarded in this way, nor is there alm any gas evolved from the platina.

The general conclusion drawn by the author from his experiments is, that the formation of a voltaic circle ge rally diminishes, and never increases chemical action, wl the liquid conductor is an oxy-acid of such a strength, t the electro-positive metal is oxidized from the decomp tions, not of the water, but of the acid itself.

Professor Mac Cullagh exhibited and described a new tical instrument, intended chiefly for the purpose of mak experiments on the light reflected by metals. The ins ment consists of two hollow arms or tubes, moveable al

the centre, and in the plane, of a large divided circle, each arm being provided with a Nicol's eye-piece, or some equivalent contrivance for polarizing light in a single plane; while in one arm, which is of course crooked, a Fresnel's rhomb is interposed between the eye-piece and the centre of the circle. At this centre is placed a stage for carrying the reflector, with its plane perpendicular to the plane of the circle, and having a motion to and fro for adjustment. Each eye-piece, as well as the Fresnel's rhomb, turns freely about the axis of the arm to which it belongs, and is provided with a small circle for measuring its angle of rotation. When the two arms are set at equal angles with the reflector, and the observer looks through the crooked arm, he will see a light admitted through the straight one; and then, by turning the Fresnel's rhomb, and the eye-piece next his eye, he will be able, by means of their combined movements, to find a position in which the light will entirely disappear. An observation will then have been made; for the light, before its incidence on the metal, is polarized in a given plane by the first eye-piece; but after reflexion from the metal, (as we know from Sir David Brewster's experiments,) it is elliptically polarized; and our object is to determine the *position* and *species* of the little ellipse in which the reflected vibration is supposed to be performed. Now, the axes of this ellipse are parallel and perpendicular to the principal plane of the rhomb, when it is in the situation above described, where the light completely disappears; and the ratio of the axes is the tangent of the angle which that plane makes with the principal section of the eye-piece next the eye. The angles are read off from the divided circles; and thus, for any angle of incidence, and any plane of primitive polarization, we can at once ascertain the nature of the reflected elliptic vibration. Professor Mac Cullagh mentioned, that the instrument was made last year with the view of testing certain formulæ which he has proposed for the case of metallic re-

flexion, and which have been printed in vol. xviii. pp. 70, 71, of the Transactions of the Academy; but that he had not yet found leisure to make the various adjustments which are necessary in order to obtain satisfactory results with it. The instrument is beautifully executed by Mr. Grubb, who himself contrived the subordinate mechanism, by which the requisite movements are effected with perfect ease to the observer.

The President read the first part of a paper by the Rev. Dr. Hincks, on the Years and Cycles of the ancient Egyptians.

The author's object in this paper is to oppose the received opinion, that the Egyptian year originally consisted of 360 days, and that at some epoch, on which learned men are not agreed, five additional days were annexed to it, in order to approximate more closely to the length of a solar revolution. His own opinion is contained in the five following propositions, which it is the business of his paper to establish.

1st. In the early part of the eighteenth century, before the christian era, there occurred a marked chronological epoch in Egypt.

2nd. Before this epoch the Egyptians used a year, of which the commencement took place at a fixed season, and the average length of which was consequently equal to the tropical year; while after this epoch, they used the wandering year of 365 days.

3rd. Between this chronological epoch, and the year of our Lord, 34, there elapsed six cycles of some sort or other.

4th. The nature of these cycles was such, that in one of them, the astronomical phenomenon which marked the commencement of the old fixed year, travelled forward through a fifth part of the wandering year, or 73 days; and

consequently, that in five such cycles, that phenomenon returned again to the commencement of the wandering year, having taken place on every day of it.

5th. The length of each of the smaller cycles was 300 years, consequently the epoch, when the wandering year was introduced was 1767, B. C.; and the first day of the first year was the 8th of November in that year, according to the proleptic Julian reckoning.

Of the truth of the first two of these propositions, the author stated that he had long been convinced; the last three were the result of an investigation recently suggested to him by a reference to a passage in Tacitus, quoted in an article on the pyramids, in Fraser's Magazine for November, 1837.

Resolved,—That the thanks of the Academy be given to His Excellency, the Lord Lieutenant, for his kindness in forwarding the work of M. De Jonnès to the Academy.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences; Premier Semestre, Nos. 9 and 10. Presented by the Institute.

Statistique de la Grande Bretagne et de l'Irlande, avec une Carte, 1837 *et* 1838. Par Alex. Moreau de Jonnès. Presented by the Author, by favour of the Lord Lieutenant.

Proceedings of the Royal Society of London, No. 31. Presented by the Society.

Transactions of the Agricultural and Horticultural Society of India.—1. *Report on the Physical Condition of the Assam Tea Plant, with reference to Geological Structure, Soils, and Climate.* By John M'Cleland Esq., Assistant Surgeon, Bengal Establishment, and Member of the Asiatic and Medical Societies of Calcutta. Presented by the author.

April 23rd, 1838.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The President continued the reading of the paper by the Rev. Dr. Hincks, on the Years and Cycles of the ancient Egyptians.

Dr. Apjohn communicated a paper upon the subject of a new and very complicated compound, consisting of iodine, iodide of potassium, and the essential oil of cinnamon.

This compound he stated to have been first observed in the winter of 1837, in a solution prescribed by a medical gentleman of this city, of iodine and iodide of potassium in cinnamon water. It is best obtained by adding to a gallon of cinnamon water four ounces of iodide of potassium, and forty grains of iodine, dissolved in a minimum of cold water. Upon admixture, the solution becomes turbid, and if the temperarature be at or close to 32°, the deposit becomes crystalline, and slowly subsides. The properties of these crystals were detailed, and a succinct account given of the different steps of the process employed for effecting their analysis.

As the result of a number of experiments, the author arrived at the following numbers, expressing the composition of 100 parts of the compound.

Iodide of potassium	12.55
Iodine	28.14
Oil of cinnamon	59.31
	100.

The empirical formula deducible from these results is

$$IK + I_3 + ci_6$$

in which *ci* represents $C_{18}H_8O_2$, the atom of oil of cinnamon,

as determined by Dumas; and the most probable rational formula he stated to be

$$\text{IK} + 3\,(\text{I} + ci_2).$$

Calculating from this formula, its composition would be

Iodide of potassium .	12.26
Iodine	28.08
Oil of cinnamon . .	59.66
	100.

This compound he considered interesting under many points of view; in consequence of its complexity, the peculiarities of its properties, and its presenting a case of incompatibility which had not been previously suspected. Also, as suggesting means which would probably lead to the production of an entire new series of substances having an analogous composition.

Dr. Apjohn stated, that this compound had been brought under his notice by Mr. Moore of Anne-street, and that he and Mr. Moore had investigated conjointly its properties, and the best process for obtaining it. Of the specimen exhibited to the Academy, sixty-one grains were obtained from a single gallon of cinnamon water.

Professor Lloyd read a paper "on a Declination Instrument, made for the Magnetical Observatory of Dublin." The instrument, which was made by Mr. Jones of London, was laid upon the table of the Academy.

The principle employed in this apparatus is the well known optical principle of the *collimator* of Kater. The needle is a rectangular bar, twelve inches in length; it is provided with three sliding pieces, one of which is at the middle of the bar, the other two near the ends. To the former is attached the suspension thread; one of the latter carries an achromatic lens, whose focal length is somewhat less than the length of the bar; the other, which is to be adjusted

to the focus of the lens, contains a cross of wires. The rays proceeding from the cross are, under these circumstances, refracted parallel to one another, and to the line connecting it with the centre of the lens,—which may be denominated the *line of collimation* of the instrument. If, then, a telescope be placed so as to receive any portion of this parallel beam, the cross will be seen in the direction of the line just mentioned; and that, independently of the exact adjustment of the telescope.

The frame-work of the apparatus consists of two pillars of copper, firmly attached to a massive slab of marble.—The height of the pillars is eighteen inches; they are connected by two cross pieces of wood, one at the top, and the other about five inches from the bottom. In the centre of the top piece is the suspension apparatus, the plan of which has been adopted from the torsion balance of Coulomb, as described by M. Pouillet. It is provided with a divided circle, for the purpose of determining the amount of torsion of the thread, and of correcting it.

The magnetic bar, suspended by parallel silk fibres, is enclosed in a rectangular wooden box, to preserve it from the agitation of the air. A glass tube, between the two cross pieces, surrounds the suspension thread, and completes the enclosure of the instrument.

The box is entirely distinct from the rest of the apparatus; it is made in two halves, which are joined at the sides by dovetails; so that it may be put on when the needle has been fully adjusted. There is a circular window at each end of the box. That nearest the observer is made of *parallel* glass; and is contained in a frame which has a motion of rotation in its own plane. By a revolution of 180°, the prismatic error, if any, is corrected. The window at the other end of the box is for the purpose of illumination. In order to determine the internal temperature, the box is provided with a small thermometer, the bulb of which

is within, and the stem (bent at right angles) on the outside front.

It is intended to employ this apparatus for three purposes; namely, to determine, first, the *magnetic declination;* secondly, the periodical and the irregular *variations of the declination;* thirdly, the corresponding *variations of the horizontal magnetic force.*

In using the instrument in the determination of the declination, it is to be combined with the theodolite and the transit instrument. The transit instrument is to be fixed close to the southern window of the observatory; there being also an aperture in the roof for the purpose of adjusting it to the meridian by means of the pole star and δ *ursæ minoris.* The centre of the theodolite is placed, as nearly as possible, at the point where the line of collimation of the transit instrument intersects that of the magnetic bar. When an observation is made, the telescope of the theodolite is directed to the lens of the magnetic collimator, and the vertical wire of the latter is made to bisect the cross in the focus of the telescope. When this is done, the line of collimation of the telescope is parallel to that of the magnetic bar. But as the latter line may not coincide with the *magnetic axis* of the bar, a similar observation is to be made with the bar inverted; and the mean of the two readings will obviously give the direction of the *magnetic meridian,* freed from the error of collimation. To determine the angle between this and the *true meridian,* the transit telescope is to be turned over, and employed as a collimator. The telescope of the theodolite being directed to its object glass, the middle wire in the focus of the transit is to be observed, in the same manner as the wire of the collimator bar was in the former part of the observation. The line of collimation of the theodolite telescope is then in the *true meridian;* and the angle read off on the limb is the supplement of the declination.

In observing the diurnal and irregular variations of the

declination, the reference to the meridian is not required. Here, therefore, the theodolite and transit instrument are unnecessary, and the former will be replaced by a *fixed* telescope, furnished with a finely divided micrometer scale in its focus.

A similar apparatus serves for the determination of the changes in the horizontal magnetic force. It is only necessary to modify a little the suspension arrangement, and to substitute for the single thread *two equidistant threads*; as in the torsion electrometer of Mr. Snow Harris. The needle is then to be turned by the force of torsion, into a position at right angles to the magnetic meridian; in which position the momentum of the magnetic force is greatest. The changes of position of the bar (read off as before by a fixed telescope with a micrometer scale) will enable the observer to deduce, by an easy formula, the corresponding changes of the magnetic force. Professor Lloyd then entered into some details connected with the theory of the instrument as thus employed; and he showed in what manner it was to be adjusted, so that a given variation of the magnetic force might produce the greatest variation in the position of the bar.

A paper was read by Edward S. Clarke, Esq., on an Improvement which he had lately made in the Sustaining Battery, and on the size proper to be given to the zinc element of sustaining batteries in general.

The author alluded to the decline of voltaic power which occurs during experiment, and ascribed to M. Becquerel the credit of having assigned its true cause; referring it, as this philosopher did, to a transfer of the decomposed substances to the respective plates, in such a way as to produce secondary currents moving in a direction reverse to the primary current.

Mr. Clarke also alluded to the fact, that Becquerel was the first person who, to remedy this evil, adopted, in 1829,

the use of a membranous partition, and two different liquids, to separate the respective metals; but added, that the form this philosopher adopted was imperfect, in consequence of the difficulty of affixing the membranous portion staunchly to the sides of the square glass box which contained the two different fluids.

The author, after referring to the sustaining battery of Professor Daniel and to the modification of that apparatus adopted by Mr. Mullins, exhibited to the Academy a battery which he had devised to remedy a defect affecting all previous combinations, and in which each surface of the hollow zinc cylinder had, as first recommended by Mr. Wollaston, a surface of copper opposed to it. An account was also given of several experiments which shewed the advantage of his form in calorific and electro-magnetic experiments.

Mr. Clarke's improvement consists in attaching a ring of zinc by zinc rivets to the top part of the outside of the hollow cylinder of zinc used in the arrangement of Mr. Mullins, and drawing a bladder over this cylinder, to which it is secured by a cord to the ring; and in replacing the earthenware jar by a copper cylinder, which is furnished with a mercury cup, as are also the zinc cylinder and the central copper. The central copper and the outer copper case are connected by a wire dipping into the cups. A solution of sulphate of copper is poured, as well into the outer case of copper, as into the bladder surrounding the central copper, and muriate of ammonia into the bladder enlosing the zinc.

The author concluded by detailing some experiments, tending to shew that, (contrary to the opinions of M. Marianini and Mr. Mullins,) the maximum effect is obtained when the surface of the zinc element is equal, or nearly so, to that of the copper.

RESOLVED, on the recommendation of the Council,—That

the by-law Chap. 7, Sect. 8, be repealed, and the following substituted:

"The Council shall, from time to time, award medals, or other honorary rewards, at their discretion."

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Premier Semestre, Nos. 12 and 13. Presented by the Institute.

Genealogical Tables of the Sovereigns of the World. By the Rev. William Betham, of Stonham, Suffolk. Presented by Sir William Betham.

ERRATUM

IN THE LAST NUMBER OF PROCEEDINGS.

Page 149, last line, *for* 0'.27, *read* 0'.297.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1838. No. 12.

May 14.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Henry Watson, Esq., William T. Kent, Esq., and John Thompson Young, Esq., were elected members of the Royal Irish Academy.

His Excellency, the Lord Lieutenant, attended the meeting as a guest.

The President read the conclusion of the paper by the Rev. Dr. Hincks, "on the Years and Cycles of the ancient Egyptians."

According to the views advocated in this paper, a lunisolar cycle of 600 years was in use prior to the deluge, its epochs being at the autumnal equinox in the years B. C. 3567, 2967, &c. The knowledge of this cycle was preserved by Noah, and diffused through the different nations at the dispersion. It was certainly used in Persia and in Egypt. In the former country, the commencement of the year was fixed at the vernal equinox by Jamshid; the epoch of this change being 7th April, 2007 B. C., when 360 years of the current cycle had elapsed. The Persian years were however reckoned from the first day of the following cycle, that is, from 6th Feb. 1767; between which and the era of Yezdigerd (16th June, A. D. 632) there elapsed exactly 2400 years of 365 days, that being the form of year introduced by

Jamshid. In Egypt, the commencement of the year was fixed at the time when the inundation of the Nile had sufficiently abated to allow the operations of agriculture to commence; and it was observed in the first instance rudely, by a nilometer, but afterwards with greater accuracy by a gnomon: the first day of the year being the first day in which the meridian shadow of an object had attained to a standard length; which standard length appears from calculation to have corresponded with a south declination of about $12\frac{1}{4}°$. The solar year, intervening between the successive occurrences of this phenomenon, was greater than the mean tropical year, on account of the changes in the equation of the sun's centre, and in the obliquity of the ecliptic; and is shewn to have been about 1767 B. C., neglecting the perturbations caused by the moon and planets, 365,243246, differing little from 365,2433 ... which would be its length, if the phenomenon gained a fifth part of a year, in 300 years of 365 days. The Egyptians, observing this equality, and being dissatisfied with the year that they formerly used, on account of the 366th day, which, occurring in every fourth or fifth year, disordered their calendar, resolved that with the next cycle they would limit the year to 365 days, allowing no more intercalations. This change they accordingly made, on the 8th Nov. 1767, from which date they commenced not only a new lunisolar cycle of 600 solar years, that is $600\frac{2}{5}$ years of 365 days, but also a cycle of the seasons, consisting of 1500 solar years, or 1501 years of 365 days. The recurrence of either of these cycles was celebrated as the return of a phœnix; and those mentioned by Tacitus, as having occurred under Sesostris, Amasis, Ptolemy Philadelphus, and Tiberius, are fixed in the autumns of the proleptic Julian years, 1167, 567 and 267 B. C., and A. D. 34. The date thus assigned for the reign of Sesostris agrees with that which Mr. Cullimore has deduced from the astronomical sculptures on the memnonium. The great period of 3000

years being the least common multiple of the two cycles, is mentioned by Herodotus as the apocatastatic period used by the Egyptians.

Professor Kane read a paper "on the Theory of Ammoniacal Compounds."

In this paper the author first noticed the various hypotheses which had been from time to time proposed to explain the nature of the combinations formed by ammonia, and adverted particularly to the remarkable fact discovered by Mitscherlich, of the isomorphism of $NH_3 + HO$ with $K.O$, and to the principle deduced by Dumas from the properties of oxamide, that NH_3, by losing an equivalent of hydrogen, formed a compound resembling very closely, and capable of replacing in combination, the simple bodies of the chlorine group.

In the theory proposed by Dr. Kane, it is laid down as the fundamental proposition, that ammonia NH_3 must be represented as a compound of the body NH_2 and of hydrogen, that is, that ammonia, as gas, is amiduret of hydrogen. The hydrogen of this body, outside the radical, may be replaced by the various metals, or by radicals of organic origin, and hence the amide of potassium, of benzoyl, &c. These amides, resembling remarkably the chlorides, may unite with chlorides or oxides of the same, or of different metals, and hence the most general proposition, that in the great mass of the various ammoniacal combinations, their real nature assimilates them to complex metallic compounds, an amide of hydrogen, or of a metal, having united with a chloride, oxide, &c. of hydrogen, or of a metal.

Thus sal ammoniac is considered in this theory as a compound of chloride of hydrogen with amide of hydrogen, and the oxide of hydrogen, united with amide of hydrogen, forms the basic element of the ordinary ammoniacal salts. In like manner, chloride of mercury, united with amide of mercury,

forms white precipitate, and calomel, united with the corresponding amiduret of mercury, forms the black powder described by Dr. Kane in a former paper. A great series of salts can likewise be obtained, which contain oxides of copper, of nickel, or of zinc, replacing the oxide of hydrogen in the ordinary ammoniacal salts; and so, in like manner, the amide of hydrogen, being capable of replacing, and of being replaced by, oxide of hydrogen in all its functions, there originates the class of basic salts, in which oxide of hydrogen is replaced by ammonia, or in which the hyperbasic equivalents of oxide are replaced by amides, or partly by amides and partly by oxides of the same metal, or of hydrogen.

To this class is referred, in great part, by Dr. Kane, the compounds formed by the absorption of ammoniacal gas, by chlorides of various bodies; thus, chloride of phosphorus and amide of hydrogen, chloride of tin and amide of hydrogen. In these bodies, the author stated, that one portion of the ammonia was generally retained more powerfully than the other, and this fact he considers to result from a dissimilarity of function in the various parts, similar to that which Graham had already pointed out in water. Thus there is

$$1 - cu\,cl + NH_3 + 2\,NH_3$$
$$2 - cu\,cl + NH_3 + NH_3.\,HO$$
$$3 - cu\,cl + NH_3 + 2\,HO$$
$$4 - cu\,cl + HO + 2\,HO$$

where the progress of the replacement is evident.

The compound $NH_3.\,HO.$ replacing potash, the author conceives that substituting for it metals of the same family, the bodies $NH_3.\,cuO$ and $znO.\,NH_3.$ should be capable of the same function; and he adopts the view suggested by Graham, that certain compounds of this kind may correspond to the ordinary double salts. Thus

$$cuO.\,SO_3 + NH_3.\,cuO.\,SO_3 + 4\,NH_2.\,H$$

corresponds to $cuO.\,SO_3 + NH_3\,HO.\,SO_3 + 4\,O.\,H$

and following out this view, along with those already de-

scribed, it becomes necessary to look upon the so-called compound radicals in a new manner.

Assuming as proved, that $NH_3 . HO$ replaces KO, and $NH_3\ HCl$ replaces KCl, hence, NH_4 replaces K.; but NH_4 is NH_2+H+H. That is, a sub-amiduret of hydrogen, compounding to certain suboxides and sub-chlorides. It may be isolated, but all that the author asserts is, that NH_3+HCl acts as $K.Cl$. He considers it impossible to avoid giving to $NH_3 + Cu\ Cl$ and $NH_3 + Zn\ Cl$ the same rank, and hence the transition to $Hg\ NH_2 + Hg\ Cl$, and similar combinations. He conceives that we cannot, in the present state of our knowledge, assign to the bodies $NH_3\ Cu$, or $Hg\ NH_2 . Hg$ the title of compound radicals, or give to them specific names, and, therefore, whilst he retains the word ammonium as convenient, and looks to the isolation of it, and to its resembling a sub-oxide, and not a metal, he considers the oxide of ammonium as more properly an oxamide of hydrogen, and sal ammoniac as a chloramide of hydrogen, as the white precipitate is chloramide of mercury, and so with various other bodies.

In the development of the theory of compound radicals, which arose from the author's investigations, two consequences were obtained, viz., that the amide replacing oxide of hydrogen, the bodies $HO.SO_3 + HO$, or $CuO. SO_3 + HO$, assimilate themselves to $HO.SO_3 + NH_3$, or $CuO.SO_3 + NH_3$, and thence the water designated saline in Graham's memoir, forms, with the metallic oxide, a compound base, to which the theory must eventually be applied; and, secondly, the further extension of the investigation shews the difficulty of drawing a line between these and the proper basic salts, of which a great number has been examined by Dr. Kane, for the purpose of obtaining evidence on these points, and the result has been, that such basic salts are constituted on the same type as the neutral salts of the same family, the water being replaced by oxide of a metal, and in many cases the metallic oxide becomes likewise hydrated by combined

water; that the equivalents of oxide are not all retained by the same force, and that if we grant to ammonium the title of a compound radical, it becomes very difficult to refuse to the basic salts, as a class, the position or title of neutral salts of compound bases, of a nature nearly similar.

Mr. Petrie read a paper on "ancient Irish consecrated Bells."

In this paper the author has first endeavoured to ascertain the period of the introduction of bells into Ireland, and states, that though it is possible that they might have been in use previously to the introduction of Christianity, he has not found the smallest authority from which it could be inferred that they were so. He next shews that there is abundance of evidence to prove, that in and from St. Patrick's time, they were generally used for the services of the church, and that the consecrated bells of the first teachers of Christianity in Ireland were afterwards applied to various superstitious purposes, of which he gives a great number of examples, from the lives of the Irish saints, ancient historical poems, annals, and other records. These bells were preserved in the churches to which they had originally belonged, and were usually enshrined in cases of the most costly materials and elaborate workmanship. The author proves that many of these bells of the earliest Christian times, though hitherto unknown to the literary world, still remain in Ireland; and he exhibited from his own museum a bell, which is celebrated in Irish history, as one of the chief relics of the people of the north of Ireland, namely, the Clog-an-udhachta, or bell of St. Patrick's will. He afterwards exhibited drawings of several ancient bells, and among others, of St. Senanus's bell, called the golden bell, preserved in the county of Clare, and the bell of Armagh, now in the possession of Adam M'Clean, Esq. of Belfast. This bell is covered by a case, or shrine, of exquisite beauty of work-

manship, and the inscriptions on it shew that it was made at the expense of Donald Mac Loughlin, King of Ireland, for Donald [Mac Amalgaid,] Primate of Armagh, at the close of the eleventh century. The name of the hereditary keeper of the bell is also inscribed on the cover, and it is remarkable that it was in the possession of one family from the period in which the case was made until it passed into Mr. M'Clean's hands. The names of the artists who made the case are also given, from which it is proved to have been of Irish manufacture.

All these bells are of a quadrangular form, and vary in height from four to fifteen inches; and that they are of the antiquity assigned them by popular tradition the author proves by a chain of historical notices, collected from the Irish annals and other records.

DONATIONS.

Registrum Vulgariter nuncupatum, "The Record of Caernarvon;" è codice MS. Harleiano 696. descriptum. Printed by command of Her Majesty, under the direction of the Commissioners on the Public Records. Presented by the Commissioners.

Rotuli Chartarum in Turri Londinensi. Accurante Thoma Duffus Hardy, S. S. A. è Soc. Int. Templ. Lond. Vol. 1, pars 1. Ab anno MC. XCIX. ad annum MC. CXVI. Printed by command of his Majesty, King William IV., under the direction of the Commissioners on the Public Records. Presented by the Commissioners.

General Report of the King in Council, from the Honorable Board of Commissioners on the Public Records, appointed by His Majesty King William IV., by a Commission dated the 12th of March, in the first year of his reign; with an Appendix and Index. Printed by command of His Majesty

King William IV., under the direction of the Commissioners on the Public Records. Presented by the Commissioners.

Catalogue of the Library of the Society of Writers to the Signet. In four parts, with a General Index. Printed for the use of the Society. Presented by the Curators of the Signet Library.

Medical and Physical Researches; or, Original Memoirs in Medicine, Surgery, Physiology, Geology, Zoology, and Comparative Anatomy. By R. Harlan, M.D., F.L.S., Lond. Presented by the author.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Par MM. les Secretaires perpetuels. Premier Semestre, No. 13, 14, 15, 16, for 1838. Presented by the Academy.

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. Ausdem Jahre 1835. Presented by the Royal Academy of Sciences, Berlin.

Preisfrage der Philosophisch. historischen Klasse der Königlich. Preunischm Akademie der Wissenschaften für das Jahr 1839. Two copies. Presented by the same.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Konigl. Preuss. Akademie der Wissenschaften zu Berlin. Erster Jahrgang, 1836, and Zweiter Jahrgang, 1837. Presented by the same.

Statique de la France; publiée par le Ministre de travaux publics, de l'Agriculture et du Commerce. Presented by A. Moreau de Jonnés.

An Original Portrait of Sir Isaac Newton, painted by Wills. Presented by Rev. Prof. Lloyd, V.P.

May 28, 1838.

SIR WM. R. HAMILTON, A.M., President, in the Chair.

Mr. Ball read a paper, by Wm. Thompson, V. P. Nat. Hist. Society of Belfast, "on the Irish Hare." (*Lepus Hibernicus.*)

This paper commenced with a review of what has been written on the subject of the Irish hare, from the time it was brought under the notice of English zoologists in 1833, until the present period. Mr. Thompson stated, contrary to what has been advanced, that the hare of England and Scotland, and that of Ireland, have long been known to differ; and that in 1807 the difference in the fur of the two species was alluded to as a matter of common notoriety, in the MS. of the late John Templeton, Esq. He further stated, that on account of their differing from the Irish species, a number of hares were, upwards of thirty years ago, brought from England, and turned out on the largest of the Copeland Islands, off the county of Down, and that many years since, the Irish hare was, for a similar reason, introduced to the island of Islay, off the coast of Scotland.

The *Lepus Hibernicus* is considered distinct from all described species. It exhibits, in several respects, characters intermediate between the British hares, *L. timidus* and *L. variabilis*, but considered generally, more nearly approximates to the former animal.

The chief result of detailed measurements is shewn in the superior length of the ears and tail of *L. timidus*, compared with those of *L. Hibernicus*. The former, or common hare, displays greater diversity of colour on the head, ears, and body, than the Irish species, which again exhibits greater variety in that of the legs. The most obvious difference in colour (and which has been unnoticed by authors,) is in the tail,

the upper surface of which is black in the *L. timidus*, and white, tinged with greyish towards the base, in the Irish species. On looking to their osteology, some slight differences are observable in the head; the comparatively more horizontal direction of the lumbar vertebra in the Irish hare is conspicuous, and likewise the relative shortness of its tail, which, as first recorded by Mr. Eyton, contains three vertebræ less than that of the English species, 13 only being possessed by the former, and 16 by the latter animal.

The occasional whiteness of fur in the Irish hare is believed by the author to be a consequence of age, and not regulated by the law that is understood to affect the *Alpine* hare, which is considered to change its dark summer fur to white at the commencement of every winter.

The economy and habits of the Irish hare, which generally correspond with those of the common species, are, together with a comparative description of form, colour, &c., very fully detailed in this paper.

Mr. Robert Mallet read a paper "on an hitherto unobserved Force of Elevation and Degradation."

The author maintains, that the forces producing geologic changes are either mechanical or chemical, and that the reaction of these forces, when co-existent, as is usually the case, often gives rise to a third order of forces, which may be denominated molecular forces, or those which, without altering the atomic composition of bodies, affect the arrangement and aggregation of their particles—modify their specific gravity—their action on light, heat, electricity, &c., and produce the varied differences of ductility, hardness, brittleness, &c. &c. While chemical and mechanical forces have been applied to geology, those of this latter class have been almost wholly overlooked.

Of the several known molecular forces, those producing change of volume and of specific gravity are perhaps the

most important, (at least to the geologist,) acting through the medium of heat, chemical combination, and crystallization. The state of our knowledge of these, as a branch of physics, is scanty and deficient, and was presented in the form of five tables, shewing—

1st. Bodies *known* to expand in volume by combination.

2nd. Bodies *known* to expand in volume on changing their state of aggregation or arrangement.

3rd. Bodies *known* to contract in volume in combination.

4th. Bodies *known* to contract in volume in changing their state of aggregation or arrangement.

5th. Bodies whose volume is *known* to remain unchanged in combination.

After stating that these tables were only brought forward as indicative of the class of forces proposed being treated of, and pointing out some of the very singular facts which they contain, of alteration of volume, and the immense force with which it frequently takes place, the author proceeded to apply the results of his own experimental determinations, of change of volume, in solutions of chloride of calcium and sulphate of soda, on mutual decomposition, and of the intermediate oxide of iron in passing to peroxide—to the salt formation of England—and shewing, that if considered as a chemical deposit, an elevation of the surface, of eight feet six inches, will have been produced, by reason of this change of volume only.

A case of observed expansion in volume, by further oxidation of the blue marl, of the saliferous system, and its remarkable effects, was brought forward, and analogy shewn with the indurating marl forming the bottom of Lake Superior. The effects of these swellings, in all directions of a mass, in producing consolidation and integration of its parts, is there pointed out.

The author then proceeds to apply this principle, to account for the formation of the contemporaneous quartz veins

in granite, which he does by shewing that the average analysis of granite gives more quartz than is necessary to the definite constitution of its ingredients; that these have crystallized from fusion, in the order quartz, mica, fellspar: and that by the successive *expansion* of each set of crystals, the residual quartz has been pushed from the surfaces of cooling, towards the central and hottest parts of the mass, there forming quartz veins.

It is suggested, that the expansion produced by *sudden* crystallization (of which instances are not wanting) may give rise to earthquakes; that the exact filling of whyn dykes, notwithstanding the contraction on cooling of the dyke and its walls, must be due to the same cause. The principle is then carried to the solution of some cases of atmospheric degradation. The Yorkshire flagstone desquamates parallel to the wrought surface, and across its lamina. This arises from induration, and crystallization of its argillo-calcareous cement, which increases in volume, and splits off the desquamated portion. The same is the case with the onion stone of the Causeway—both desquamate by air and moisture, without the agency of frost. Lastly, it is shewn, that this expansion in volume does not always necessarily infer disruption.

The author intends his paper only as an indication of a wide class of forces, as yet little considered or applied by the geologist, and which, although from the present condition of geology as a science they cannot be often estimated, must, in its future progress, form an important element of connexion in all its greater problems.

Mr. Samuel Ferguson read a paper, entitled "Remarks on the late Publication of the Society of Northern Antiquaries."

The object of this paper was to add some corroboratory evidences to the fact established in the Antiquitates

Americanæ, published by the Royal Society of Northern Antiquaries, that the Irish had been acquainted with the continent of North America previous to the time of Columbus.

From the fact that at least two sorts of dye-woods were known in Europe by the name of *wood of Brasil*, before the discovery of the American continent, the author inferred that Brasil was the name of an already discovered country, from which these woods had been brought. But a country of indefinite magnitude, called the island of Brazil, is found marked in numerous maps, made before and about the time of Columbus; and from the position of this country in the Atlantic, to the south-west of Ireland, it cannot be identified with any other part of the world than the continent of North America. Again, from its being represented as bounded, at least on two sides, by the sea, and divided by a great river, it appears to correspond more peculiarly with the southern states of North America, between the Atlantic and the the river Missisipi. But this is *Irland it Mickla*, or Great Ireland, the district which the northern histories represent as inhabited by a *white Christian* people, speaking a language like the Irish; and logwood, which is often confounded with Brazil wood by the earlier naturalists, grows as far north as these latitudes.

Hence it was surmised, that possibly the precious *mausur* wood, spoken of in the northern histories as having been brought by the Scandinavians from America, may have been one of the dye-woods known in Europe before the time of Columbus, by the common name of Brazil wood.

Further, in one of the maps referred to, the island of Brazil is represented south of another island, of indefinite magnitude, called "Mons Orins," which would thus appear to be referred to the position of the Scandinavian settlement of Vineland. But in the state of Rhode Island, which the Northern Antiquaries identify with part of the Vineland of

their histories, is a stone, covered with sculptures and inscriptions of the ante-Columbian era, on which the word ORINX, or as some read, ORINS, is the only one legible.

Again, the tradition of the island of O'Brazil is still vividly preserved, both by the Irish and the Welsh, and it is by this name the latter indicate the country alleged to have been discovered by their Madoc. So strong was the belief in this tradition in Ireland, in the seventeenth century, that a patent is said to have been taken out for the island, when it should be discovered, and a pamphlet, purporting to be an account of its discovery, obtained circulation in London in 1675.

From these considerations the author inferred, that perhaps the story of St. Brendan, who is said to have spent seven years in the land of promise, at the other side of the Atlantic, may not have been altogether without foundation, and that if so, it is not improbable that Christianity may have been introduced into the new world by Irish ecclesiastics of the 6th century.

Professor Kane read a paper "on the Ammoniacal and other Basic Compounds of the Copper and Silver Families."

Having verified Berzelius' formula for the ammoniacal sulphate of copper $Cu\,SO_3 + 2\,NH_3 + HO.$, Dr. Kane pointed out, that, from the circumstances of its formation, and others, the real formula must be $(NH_3HO + SO_3) + NH_3.Cul$; and that by heat it loses $NH_3.HO.$ and leaves a compound $NH_3.Cu\,O + SO_3.$; by still more heat there remains $2\,SO_3 + 2\,Cu\,O + NH_3$ or $CuO.SO_3. + (NH_3.Cu\,O)\,SO_3.$ and by water there is formed the ordinary basic sulphate $CuO.SO_3 + 3\,CuO + 4\,HO.$

Dr. Kane describes likewise a new basic sulphate as $SO_3 + 8\,Cu\,O + 12\,HO.$ and he arranges these two salts as

$$1 = Cu\,O.SO_3\,Cu\,O + 2\,(Cu\,O + 2\,HO).$$
$$2 = Cu\,O.SO_3.\,Cu\,O + 6\,(Cu\,O + 2\,HO).$$

and seeks to establish an analogy with the ordinary salts of the same family, as

$$ZnO.\,SO_3\,HO + 6.\,HO \text{ and } Cu\,O.SO_3.Cu\,O + 6\,Cu\,O$$

Dr. Kane found the ammoniacal chloride of copper to be $cu\,cl + 2\,NH_3 + HO$. or correctly, $NH_3.\,H\,cl + NH_3.\,cu\,O$. By heat $NH_3\,HO$ is lost, and there remains $NH_3.\,H\,cu\,cl$. By water there is generated a new basic chloride of copper, having the formula $cu\,cl + 4\,cu\,O + 6\,HO$. The common Brunswick green $cu\,cl + 3\,cu\,O + 4\,HO$. Dr. Kane has obtained with 6 HO in place of 4 HO. and these oxychlorides he considers as formed on the type of the ordinary chlorides, combined with water, or with metallic oxides in other groups.

$$1 - cu.\,cl + cu\,O + 2\,(cu\,O + 2\,HO)$$
$$2 - cu\,cl + \quad 3\,(cu\,O + 2\,HO)$$
$$3 - cu\,cl + cu\,O + 3\,(cu\,O + 2\,HO).$$

When No. 2 is heated, it loses all water, but if then put into contact with water, it regains 4HO, and becomes perfect Brunswick green No. 1. $cu\,cl.\,cu\,O + 2\,(cu\,O + 2\,HO)$.

The second equivalent of oxide is, in these chlorine bodies, much less forcibly held than in the sulphates, but that it is differently related to the acid than the remaining equivalents of oxide or of water is proved by a great variety of facts.

The ammoniacal nitrate of copper has the formula $cu\,O\,NO_5 + 2\,NH_3$. or $(NH_3.HO.)\,NO_5 + cu\,NH_2$. hence this body contains, united with the copper, amidogen; when heated it explodes, the copper and amidogen burning in the nitrous oxyde yielded by the nitrate of ammonia. To obtain some analogical evidence regarding this body, Dr. Kane re-examined the ammonia-sulphate and nitrate of silver, and found George Mitscherlich's results good. Dr. Kane, however, writes the formulæ

$$1 - (NH_3.HO).\,RO_3 + Ag.NH_2$$
$$2 - (NH_3.HO)\,NO_5 + Ag\,NH_2.$$

This last salt, when heated, gives a beautiful decomposition; the nitrate of ammonia fuses readily, and at a temperature below that at which it decomposes, the amide of silver is resolved into ammonia, nitrogen, and metallic silver, which

latter being deposited on the sides of the glass, from the liquid nitrate of ammonia, gives a mirror surface equal to that obtained by aldehyd.

On analysing the ammoniacal compounds of nickel, Dr. Kane found the results of Erdman completely verified; but from the inferior affinity with which the ammonia was retained, these compounds did not yield as positive results as to their influence on theory, as those of the copper class.

A new substance, discovered in the course of these researches, may be termed a fulminating copper. It is a blue powder, decomposed by heat into metallic copper, water, ammonia, and nitrogen. Its formula is $3 CuO + 2 NH_3 + 6 HO$.

The examination of the zinc compounds has lead to the discovery of a considerable number of new bodies. The ammoniacal sulphate of zinc crystallized is

$$1 - ZnO.SO_3 + 2NH_3 + 3 HO$$

exposed to the air, it efflorescences losing HO, and becomes

$$2 - ZnO.SO_3 + 2 (NH_3.HO).$$

which, if heated, gives at 212°F.

$$3 - ZnO.SO_3 + (NH_3.HO.)$$

but at dull redness loses still $NH_3.HO$ and leaves $ZnO.SO_3$.

If No. 1 be exposed longer to a moderate heat it loses $2 HO$. and there remains,

$$4 - ZnO\ SO_3 + 2 NH_3 + HO$$

If this be heated to 300°, it loses $(NH_3 HO)$ and there is

$$5 - ZnO.SO_3 + NH_3.$$

which further gives by heat

$$6 - 2 (ZnO.SO_3) + NH_3$$

from which the ammonia cannot be expelled without decomposition.

Selecting from among these No. 2, for reduction to its rational formula, it becomes

$$(NH_3.HO.)\ SO_3 + ZnO.\ (NH_3.HO).$$

the oxide of zinc from the sulphate being redissolved
tash, there must be formed the similar compound

$$K.O.SO_3 + zn O.KO.$$

cannot be obtained crystallized, for if the liquor be
rated there is deposited $KO.SO_3$, and $zn O.KO$ remains dis-
l; from this, by exposure to the air, there are gradually
ited small crystals, which Dr. Kane considers as being

$$KO.CO_2 + zn\,O.CO_2 + 2\,HO.$$

y heat there is carbonic acid given off, and a powder
ble in water is produced, the composition of which,
Dr. Kane's examination, appears to be

$$KO.CO_2 + zn O.CO_2 + 2\,zn O.$$

l be recollected, that the bicarbonate of potash is

$$KO.CO_2 + HO.CO_2.$$

y treating the ammonia sulphate No. 3 or 5 by water,
is obtained a basic sulphate, having the formula

$$zn O.SO_3 + 6\,zn O + 12\,HO.$$

, dried and exposed to the air, slakes, and gives

$$zn O.SO_3 + 6\,zn O + 3\,HO.$$

new salt has some remarkable relations to those already
l.

here are two ammonia chlorides of zinc.

o. 1, in pearly scales of a talcy lustre, consists of

$$zn\,cl + 2\,NH_3 + HO,$$

when heated, gives off $NH_3.HO$. leaving $NH_3.zn\,cl$. a white
r.

o. 2 is in fine quadrangular prisms, brilliant lustre, con-
of $2\,zn\,cl + 2\,NH_3 + HO$. or, as Dr. Kane considers,
$+ (NH_3.HCl) + NH_3.zn O$. which losing $NH_3.HO$ leaves
$+ NH_3.zn\,cl$. a white mass, fusible, congealing into a
ike gum, and volatilizable. This gummy mass is like-
btained by heating $NH_3 zn\,cl$.

There is generated by the action of water on these basic ammoniacal compounds, an oxychloride of zinc of a very remarkable character: it is—

$$zn\,cl + 6\,zn\,o + 12\,HO.$$

dried, it is reduced at 212° to 9 HO + and by 300° to 6 HO. By 500° all water is driven off, and there remains $zn\,cl + 6\,zn\,o$ which exposed to the air absorbed 3 HO. Hence the general expression is

$$zn\,cl + 6\,zn\,o + 3\,HO + 3\,HO + 3\,HO + 3\,HO$$

and comparing some similar chlorides, there is,

1 $ca.cl + 6\,HO$ crystallized chloride of calcium.
2 $zn\,cl + 6\,zn\,o$ — basic chloride of zinc dry.
3 $H\ cl + 6\,HO$ — strong muriatic acid.
4 $zn\,cl + 6\,zn\,o + 12\,HO$ — hydrated oxychloride of zinc.
5 $H\ cl + 6\,HO + 12\,HO$ — muriatic acid with a constant boiling point.

Another oxychloride, having the composition

$$zn\,cl + 9\,zn\,o + 15\,HO$$

which dried and exposed to air, absorbs 6 HO. Hence it may best be considered as

$$(zn\,cl + 6\,zn\,o + 12\,H\,o) + 3\,(zn\,o\,HO),$$

giving ultimately

$$(zn\,cl + 6\,zn\,o + 3\,HO + 3\,(zno + HO)$$

Mr. Petrie then read the following Report, from the Committee of Antiquities:—

At a meeting of the council, on Monday last, the President read the following letter, which he received from Mr. Drummond, the Under Secretary of State.

Dublin Castle, May 19, 1838.

"My dear Sir,

"I am informed, that in levelling a mound in the Phœnix Park, on the eastern flank of the

Hibernian School, an ancient tomb has been discovered, which is of considerable interest, and fitted to throw much light on the disputed question of the origin of 'cromlechs.'

"I beg, therefore, to suggest, that a deputation from the Royal Irish Academy should visit and examine this tomb.

"I am, my dear Sir,
"Very faithfully yours,
"T. Drummond.

"*Sir Wm. Rowan Hamilton,*
"*&c. &c.*"

In consequence of this communication, the council appointed the Committee of Antiquities as a deputation from the Academy, to examine and report on the circumstances connected with this interesting discovery; and the Committee accordingly, with the President and many other members, assembled on the spot, on Wednesday last, and made the examination, and ascertained the particulars of which they now present their Report.

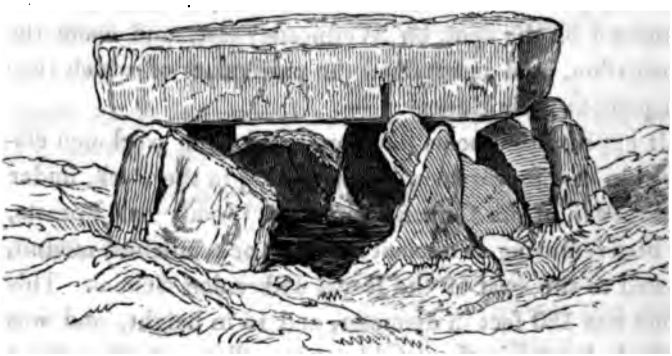
It appears that some days previously, the workmen employed in the improvements now making in the Park, under the direction of the Commissioners of Woods and Forests, had been removing an ancient tumulus, or sepulchral mound, situated to the west of the Royal Hibernian School. This mound was 120 feet in diameter, and 15 in height, and was popularly known in the neighbouring village of Chapelizod by the Irish appellation of Cnoc-maraidhe, a name which, according to the best Irish scholars who have been consulted, appears to signify the hill of the mariners. This tumulus appears to be surrounded by several smaller ones, not yet disturbed.

Within the tumulus, but at the distance of several yards from the centre, the men discovered four small sepulchral vases, containing ashes of burned bones. These urns were enclosed within small stone kists, but were unfortunately

broken through want of care in the excavation. One of th
however, is nearly perfect, having fortunately been sa
by Mr. Larcom, who was riding past the spot shortly a
their discovery.

These urns, which, as usual, are of baked clay, exh
a greater degree of taste in art than those commonly fou
particularly in one example, which is unfortunately brol
and on which the ornaments are in relief.

Subsequently, in the centre of the mound, a tomb
discovered, and the workmen were stopped from proceed
further, in order that its examination might be directed
the deputation from the Academy. That this course wa
judicious one, and led to discoveries interesting to a
quarian science, which would not otherwise have been ma
will appear from the following results.



The tomb consists of a table, or covering stone, 6 f
6 inches in length, from 3 feet 6 inches to 3 feet in breadth, a
14 inches in thickness. This stone rested on five support
stones, varying from 2 feet 6 inches to 1 foot 3 inches
breadth, and about 2 feet in height. Of these supporters th
was one which did not actually touch the covering sto
a small stone, since removed, having been wedged betw
it and the latter; and there were five other stones, not u
for supports, but as forming the enclosure of the tomb. C

of these, on the east side, was removed, that the interior might be examined. The apertures formed by the irregularities in the shapes of these stones were filled up by smaller stones, placed against them, to prevent the stones and earth of the tumulus from falling into the tomb. All these stones are limestone, and, with the exception of the covering slab, water-worn, and even the latter appears to be partly so.

In the recess thus enclosed, two perfect male human skeletons were found, and also the tops of the femora of another, and a single bone of an animal, supposed to be that of a dog. The heads of the skeletons rested to the north, and, as the enclosure is not of sufficient extent to have permitted the bodies to lie at full length, they must have been bent at the vertebræ, or at the lower joints. In both skulls the teeth are nearly perfect, but the molars were more worn in one than in the other.

Immediately under each skull was found collected together a considerable quantity of small shells, common on our coasts, and known to conchologists by the name of *Nerita littoralis*. On examination, these shells were found to have been rubbed down on the valve with a stone, to make a second hole—for the purpose, as it appeared evident, of their being strung to form necklaces; and a vegetable fibre, serving this purpose, was also discovered, a portion of which was through the shells.

A small fibula of bone, and a knife, or arrow-head, of flint, were also found.

For the preservation of all these interesting remains, which His Excellency the Lord Lieutenant has presented to the museum of the Academy now forming, the Academy are indebted to Mr. Drummond, and to the zealous exertions of Mr. Larcom, who has had a case made for their present safety.

How far the discovery of this tomb may contribute to settle the disputed point among antiquaries, of the original purpose of the cromlech, or whether this sepulchre properly

belongs to that class of monuments generally supposed to have been altars, or that called kiswaens, which are acknowledged to have been tombs, it is not for this Committee collectively to express an opinion; but, from the rudeness of the antiquities discovered within its enclosure, they may venture to refer the date of its erection to the earliest period of society in Ireland; and as it has been ascertained that interments of different ages have been made within the same tumulus, it may also be inferred, with every appearance of probability, that the urns found within this mound, from the superior degree of art exhibited in their ornaments and formation, should be attributed to a later age than the original tomb.

The thanks of the Academy were voted to His Excellency the Lord Lieutenant.

The thanks of the Academy were also voted to Mr. Drummond and to Mr. Larcom.

DONATIONS.

Memoires de l'Academie Royale des Sciences Morales et Politiques de l'Institut de France. Tome 1, (2 Série.) Presented by the Academy.

Comptes Rendus Hebdomadaires des Séances de l'Academic des Sciences; Par MM. les Secretaires Perpetuels. Premier Semestre. Nos. 17, 18, for 1838. Presented by the Academy.

Journal of the Statistical Society of London. No. 1, May 1838. Presented by the Society.

Proceedings of the Royal Society. Nos. 31, 32. Presented by the Society.

Transactions of the Historical and Literary Committee of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge. Presented by the Society.

Catalogue of Circumpolar Stars, deduced from the observations of Stephen Groombridge, Esq. F. R. S., S. R. A. Nap. &c. &c. Reduced to January 1st, 1810. Edited by George Biddell Airy, Esq. A. M. Astronomer Royal. Printed at the public expense, by the Lords Commissioners of the Admiralty. Presented by the Lords Commissioners of the Admiralty.

The Ordnance Survey of the County of Roscommon, in fifty-eight sheets, including the Title and Index. Presented by His Excellency the Lord Lieutenant.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1838. No. 13.

June 11.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Godfrey Levinge, Esq., John H. Lecky, Esq., William Brennan, Esq., and David Aher, Esq., were elected Members of the Academy.

Dr. Kane read a notice "On the Action of Arseniuretted Hydrogen on Sulphate of Copper, and on the Manganese Alum analysed by Dr. Apjohn."

The author stated, that on passing dry arseniuret of hydrogen over dry sulphate of copper, it is absorbed with the evolution of considerable heat; much water is evolved, and a black mass is formed, which consists of sulphuric acid, arsenic, and copper: the whole of the oxygen of the oxide of copper being removed with the whole of the hydrogen of the arseniuret of hydrogen. The re-action is

$$\begin{array}{c} 3\,(\mathrm{SO_3} + \mathit{Cu}\,\mathrm{O}) \\ + \\ (\mathit{As}_2 + \mathrm{H}_3) \end{array} = \begin{array}{c} (3\mathrm{SO_3} + \mathit{As}_2\,\mathit{Cu}_3) \\ + \\ 3\,(\mathrm{HO}). \end{array}$$

The formation of this body, appears to Dr. Kane to render probable the idea that a quantity of arsenic equal to one-third of the double equivalent, $\frac{75,4}{3} = 25,13$, combining with metals may form compounds similar to oxides, and thus the body just noticed be a sulphate of that arseniuret of copper.

$SO_3 + \frac{2 As}{3} + Cu$. When this body is put into contact with water, sulphate of water is formed, and arseniuret of copper deposited; this arseniuret being likewise at once precipitated, when arseniuret of hydrogen is passed into a solution of sulphate of copper.

Dr. Kane found also, that when arseniuret of hydrogen is passed over chloride of copper, chloride of hydrogen is set free, and the same arseniuret of copper is produced,

$$Cl.Cu + \frac{2 As}{3} H = \frac{2 As}{3} Cu + Cl H.$$

In examining the constitution of the alum, the analysis of which by Dr. Apjohn, was read to the Academy last winter, Dr. Kane found that the water had been estimated by that chemist a little too high; thus Dr. Apjohn gave 48,15, while the true quantity amounts to 47,60. This small variation, however, makes, according to Dr. Kane, an important difference in the theory of the body, as the number of equivalents is reduced to 25 in place of 26: and Dr. Kane looks upon the salt as composed of—

Sulphate of Manganese $MnO.SO_3.HO + 6 HO$.
Sulphate of Alumina $Al_2 O_3 + 3 SO_3 + 18 HO$.

$$(Mn O.HO) SO_3 + (Al_2 O_3 + 3 SO_3) + 6 HO + 18 HO.$$

In a temperature of 212° this salt loses 18 HO, and by 300° six of the remaining atoms. The twenty-fifth atom is retained up to 600°: and Dr. Kane looks upon this salt as a remarkable case of the replacement of amide of hydrogen by an oxide of the same class; he further stated that it was by this principle he was led to the repetition of Dr. Apjohn's analysis.

Sir William Betham read a paper "on Etruscan Hand Mirrors," particularly that figured in Dempster's posthumous work *De Etruria Regali*, Vol. I. Tab. I, p. 78, from the original in the Cospian Museum at Bologna.

These mirrors have been found in great numbers in Italy, as well in the sepulchral chambers of the Etruscans as in other excavations. One side was polished for the mirror, the other generally engraved with a representation of some mythological allegory. That under consideration represented the birth of Minerva.

The figures and inscriptions are reversed by the engraver in Dempster's plate.

The author suggests that most of the fables of the Greeks and Romans are but mutilated versions of the allegorical emblems of a previous people, and that people the Etruscans, who, as well as the Celts, were a Phœnician colony. The Umbri have long been considered Celts, and if the Etruscans were the same people, they also were Celts. The former, Sir William thinks, were called *Umbri* from their locality, (om, *distant*, bրι, *hills*); they inhabited the remote hilly country of Italy.

In this allegory *Tinia* (Jupiter) is represented in a sitting posture, with the thunderbolt, and the mystic rod in his hands; above his head is the infant goddess, with a shield on her left arm and a spear in her right; before him stands a dressed female figure, with arms elevated towards Minerva, and from her mouth the word THAR, ṫaր, (*come,*) as if inviting the new-born deity. Behind this figure is a female nearly naked, having but a shawl thrown round her middle, and sandaled. In her left hand she holds an axe with a double blade, resting on her shoulder; before her are the words SETH LANM, ꞅeṫ lanaım, (*the hole I cut.*) Behind *Tinia* is another female figure nearly naked, with her arms around the body of Jupiter, as if supporting him, and behind her the word THALNA, ṫal na, (*the axe;*) also a tree with a bird, perhaps the eagle, upon it.

Sir William suggested this explanation of the allegory: TI NIA, ṫı nıa, *the splendid being; the great spirit,* or Jupiter;

IUD BI TER, (ıuó bı ƭeɲ), *day's great being*, is represented as a king or warrior, who by the axe of *Bellona*, the goddess or allegorical representation of experience in war, concieves the idea of *military strategy, wisdom, and discipline*, and produces it *from his head*; and Minerva is thus the allegorical representation of wisdom, firmness, and military discipline, produced by the axe of Bellona, or experience in war.

The Greeks and Romans, substituting Vulcan's axe for Bellona's, seem to have spoiled the elegance of the allegory, unless they meant that armour was the perfection of warlike preparation.

Sir William Betham read a paper "on the Ancient Tomb recently discovered in the Tumulus in the Phœnix Park."

This paper is here inserted without any alteration or abridgment.

"When the Report of the Committee of Antiquities on sepulchral monuments recently discovered in the Phœnix Park, was read to our last meeting by Mr. Petrie, I ventured to object, at the moment, to the meaning therein assigned to the name of the hill *Knock-Mary*, (cnoc maɲaıðe), the *hill of the Mariners*. It struck me that the troubleand expense of time necessary to construct this monument were not likely to have been expended on the bodies of *two mariners*, and, therefore, I suggested, that the meaning was most probably cnoc ma ɲıᵹ, *the hill of the good king*, or meaɲ ɲıᵹ, *the fortunate, lively, active*, or *successful prince*; either of which characters appeared to me to suggest a more probable origin ofthe name than that assigned in the Report of the Committee.

"The Rev. Mr. Otway stated, that the name of *Knockmaroon*, another hill in the neighbourhood, had reference *to mariners*; and that certain hills in the neighbourhood of Sligo, which he had recently visited, bore like names, and contained similar monuments, though of much larger dimensions.

"These statements from individuals of acute judgment and

correct observation on such subjects, induced me to hesitate as to the accuracy of my own conclusions, but did not convince me of the correctness of theirs. I have since considered the subject more at leisure, and am now convinced that neither of the opinions expressed at our last meeting was correct.

"But before I enter upon the question of the meaning of the name, I shall say a few words on the probable period of the erection of the monument itself, and of the people concerned in its construction.

"The circumstances and manner of its formation, as well as the urns of unburned clay, the small *flint knife,* and other considerations, convince me that the work was not constructed by the Celtic Irish,—I mean the people whose language is now called *Irish,* and spoken among us,—but by a previous people who inhabited the island at the first arrival of the Celts, and were known by the name of *Firbolgs,* or *Belgæ.* The shells which were found suggest a meaning for this name of that people, which is, I believe, quite new, at least it is so to me. The name of Firbolg has generally been rendered ꞅeaꞃ, *a man,* bolᵹ, *of a bag, pouch, or sack,* and also bolᵹ, *a boat* or vessel made of the skins of animals, a *coracle;* but bolloᵹ is also *a shell,* and *a round shell,* it is also *a skull,* or *bone of the head,* intimating a similarity between the two things; the *neritæ* found in this sepulchre are exactly of this character, and seem to indicate that these people were called, by their Celtic conquerors, ꞅeaꞃ bolloġ, from the circumstance of their wearing an abundance of those shells by way of ornament. They also called them bꞃiꞇ ꝺaoiꞃe *painted* (or parti-coloured) men, for the reason that they stained their bodies; hence the name *Britain,* given to both the islands inhabited by these people. Their descendants, who by retiring to the north of Britain, were preserved from the annihilation which those of the south suffered from the Celts, were called Picts, or *painted men,* by the Romans. It may be, that while

the southern Britons were extirpated, those who inhabited the different northern regions of modern Scotland were able to preserve their independence, and were found by Agricola under the name of Caledonians, a people who were of a florid complexion, and whose other features indicated a German extraction.

"The *Flint* knives, daggers, arrow heads, spear heads, stone hammers, and chisels, which have been found in Ireland, in great quantities, are so exactly similar in form and character to those found in *Funen, in Denmark*, and figured and published by the Northern Antiquarian Society, that those figures on their plates might be taken as correct representations of our Irish articles. A very remarkable instance is to be found in a flint dagger in our own *Museum*, which I now lay before the Academy, with the Danish plate. Denmark was the country of the *Cimbri*, the descendants of the Caledonians: the *Welsh* have ever, and still call themselves by that name. The places in that part of Scotland, of which the Picts last retained possession before their extirpation by the Scotch from Ireland, still abound in Welsh denominations, and seem to me to offer unquestionable testimony, when all these circumstances are taken together with the occurrence of similar monuments in all the British islands, and in Denmark, that they are of the Belgic or Firbolg people; and the Belgæ and Cimbri were people of the same primitive northern race, using stone weapons and tools; perhaps the first inhabitants of these countries.

"I now proceed to say a few words on the name of the hill *Knock Mary*, and its adjoining neighbour, *Knockmaroon*.

"These names being Celtic Irish, and in the language of the nation which succeeded the people who constructed these monuments, could have no reference to the individuals buried, but must have been given to the things themselves, and consequently must have been of a generic character, and applicable generally. The Celtic Irish were the people

who used bronze instruments, and consequently a people more advanced in civilization than the Firbolgs, who built these monuments and used instruments of flint, the most primitive of all; they, however, knew the uses for which they had been constructed, and that they were places or *hills of sepulture*, and called them by that name cnoc marḃ, or *the hill of the dead*, and cnoc marḃun, *the hill of the dead bodies*, otherwise, the hill of burial.

"I cannot bring myself to believe that these monuments were the work of the Danes of Dublin, of Christian times, because the flint knife, and the rude urns of unbaked clay, are indicative of a much earlier period. The Danes of Dublin, and the Scandinavians of that period, were too far advanced in civilization, to justify us in entertaining such a notion as tenable for a moment; and, therefore, I would refer this monument to a most remote antiquity, at least of three thousand years, as certainly the Celtic invasion must have taken place near fifteen hundred years before our era.

"The character of this monument of antiquity is altogether similar to the Cromlech, and its undoubted sepulchral character would induce the conclusion that all cromlechs were sepulchral, and nothing more than chambers of the dead. New Grange itself would, if denuded, give the appearance of an immense specimen of the sepulchral chamber. It might be worthy of consideration, whether that or some other large tumulus should not have the earth which conceals its structure removed, and the stones left as a demonstrative exhibition: for myself, I think it would be well worth the expense of such an undertaking, if other circumstances did not make it impracticable.

"The application of the term *altar* to the Cromlech I have long considered very problematical, and *Druid's* altar still more doubtful. I am now nearly convinced that these monuments are not Druidical or Celtic. We have no evidence

from history that the Celts ever sacrificed on such an altar, or even built one; and it is not probable that Cæsar and other writers who treat of the Celts, would have passed over so remarkable a fact, especially as Cæsar, enters so minutely into the ceremonies of the Druids and their religious rites. To enter into this part of the subject fully, would occupy more time and space, and interfere with other subjects which are of more pressing interest to me at this time, but I may be allowed just to observe in this place, for the reasons above stated, that I consider all cromlechs as denuded sepulchral chambers, and that they are the works of the Cymbric Belgæ. I think the evidence we possess on the subject, all tends to induce that conclusion."

Sir William Betham read "A Translation of the fifth Eugubian Table," as numbered by Dempster.

He stated that he considered this Table the first in chronological order, although numbered the fifth; for as the writing of the first five Tables was from right to left, so, he conceived, the numbering ought to have been the same way. Sir William also stated that as he intended to read translations of all the Tables in succession; he would wish to defer the printing of those he had read on the 22nd of January, until the previous Tables had been laid before the Academy.

These Tables Sir William considers as narratives of Etrusco-Phœnician voyages; and as the account of Hanno's voyage along the west coast of Africa, was placed up in the Temple of Saturn at Carthage, so he conceives were these fixed up in the temple at Eugubium, in accordance with the custom of the Phœnician people.

The voyage, of which this table is an account, was from Etruria to *Carne*, in the island abounding in cattle, (Britain). It commences with the departure of the expedition, and tells us that proceeding to *the Mouth* of the Straits, they encoun-

tered an opposing current, which they overcame, and entered *the Port*, (Cadiz), where they got a supply of good water. They sailed again with favourable winds and currents for some time, when they encountered a foul wind, and having succeeded in making the land, they again obtained water, and proceeded on to Carne, where they arrived safely.

The description of the country follows: showers fell frequently, the wind was boisterous, and the sea rough. Nearly west, about a day's sail, was another island country which the men saw on the voyage. The country they were in was green, fertile, and fit for habitation. The frequent showers created many brooks and rivers, which watered the country well. They had plenty of food. They were surprised by an *extraordinarily great fall of the tide*, which left the strand dry; but it was fortunate, as it enabled them to stop the leaks of their ship which were bad.

The island is represented as the largest of islands; and the success of the first attempt is represented as encouraging to future voyagers, the safety of passing the ocean having been demonstrated. They had deers' milk to drink. The country is described as hilly.

The superiority of their seamen and skill depends on being well supplied with food; and much is said about the consequences likely to follow the progress they had made in navigation, and their knowledge of tides and currents.

On their return, when they got to the hot climate, they were attacked with the scurvy, having had no rain for twelve days; but the wind was fair, and the sea favourable. They arrived in safety at *the Mouth*, and entered the Port, (Cadiz), where they stopped three days, and obtained a supply of provisions and water. The *ruddy* appearance of *the Mouth* (*Gibraltar*) is described, and the *favourable current* into the Mediterranean, into which they sailed, and in three days more arrived at their home in safety.

George Downes, Esq., M. A. read a paper entitled "Some Remarks on the *Antiquitates Americanæ*, lately published in Copenhagen."

The author, after remarking that this volume, which had appeared under the auspices of the Royal Society of Northern Antiquaries, contained an account of the early discoveries of the Northmen in America, stated the two-fold nature of his object :—

1st. To advert to some leading features of the past researches of the Society in connexion with those discoveries.

2nd. To hazard a conjecture respecting their future researches.

The author observed, in the first place, that the present account, although not altogether new, was not only more correct than any other, but supported by evidence, drawn partly from Icelandic MSS. nearly coeval with the principal events recorded, which took place about the opening of the eleventh century, partly from the modern researches of learned Americans. He stated that, as Arctic discoverers of America the Northmen attained as high a latitude as the most distinguished modern navigators; and detailed the Icelandic geography of the eastern part of North America, from Cumberland Island to the Chesapeak. He next adverted to the Irish part of the same continent, supposed to extend from the Chesapeak to the Gulf of Mexico, and inwards to the Mississippi. This tract was called *Whitemensland*, or *Great Ireland*, and was inhabited by an Irish colony prior even to the Norse ante-Columbian discoverers of America. Evidence of this fact was adduced from the *Antiquitates Americanæ*, in the form of two traditions :—one held by the Shawanese Indians who had emigrated from Florida to Ohio; the other by the Faroese islanders. To this evidence the author added a conjecture of his own, founded on the similarity between the first part of the word *Estotiland* (a name of the Icelandic *Vineland*, which does not occur in the work,) and *Scotia*, an old name of Ireland.

After alluding to some passages respecting the mysterious territory of Great Ireland, as given in the adventures of Thorfinn Karlsefne, Gudleif Gudlaugson, and Ari Marson, the author proceeded to animadvert on three inferences deduced from the *Antiquitates Americanæ*, in a paper read at the last meeting of the Academy.

1. The explanation of the surname of Ari Marson—" son of the sea"—in the ordinary sense of a person of unknown parentage, arrived by ship from some unknown land, was denied to be tenable, as the genealogy of Marson is given in both a textual and tabular form. The figurative meaning—that of one addicted to nautical pursuits, or distinguished for naval enterprise, was also impugned—as likely to be employed in the language of the Celts, who were averse from navigation, but by no means in that of the Icelanders, who were all *sons of the sea*, and among whom domiciliation on board formed even a part of the Viking code of laws. The author added, that the sculptor Thorwaldsen, and Professor Finn Magnusen, were both descended from Ari Marson; and that the name of an Irish princess, called *Ingebiœrg* in Icelandic, Ingijbœrg in Farvish, but supposed to be Inivaca, also appeared in the genealogy.

2. The author next disputed the identity of Brazil wood with *maser*, a wood of New England, the Vineland of the Northmen, citing Dr. Bancroft's description of the former. He denied that Brazil-wood had ever been found in a latitude so far north, and contended that intelligent savages usually discover the dye-stuffs within their reach, but that the Skrælings, or Esquimaux, who encountered Thorfinn Karlsefne, bought red cloth from him with avidity, being evidently attracted by the novelty and brilliancy of the colour; that the Skrælings were an intelligent race appeared evident from their possessing a kind of *balista*, and other warlike engines unknown to the Northmen. To refute the possible objection that Brazil wood, if a product of ancient

Vineland, might have been used as an ornamental timber, various passages were translated from the Icelandic, which were accompanied by the opinion of the editor of the *Antiquitates Americanæ*, from which it appeared that the *mazer* was a kind of *maple*, a tree which still flourishes in New England ; and this opinion was further supported by a line from Spenser's Fairy Queen, and by the etymological similarity of the word *mazer* to the Latin *acer*.

3. In reference to an inscription on the Assonet Rock, in Massachusetts, the author alluded to the improbability that Thorfinn Karlsefne—the limit of whose discoveries is supposed to be marked by the rock—would have omitted all mention of his own name in recording them ; and showed that certain letters, on the supposed absence of which another theory had been formed, were present in the most approved copies of the inscription, three drawings of which were exhibited to the Academy.

Mr. Downes in the second place, propounded his conjecture respecting the future discoveries of the Northern Antiquaries in the field of American research. From the similarity both in spelling and meaning of *Haiti*, "highlands," (the restored name of St. Domingo, or Hispaniola,) to the Icelandic local designation *Heithi*, as well as that of *Bohio*, "the house," (another name of Haiti,) to the Icelandic *bud*, (the English "booth,") also used as a local designation in that language, he inferred that the Northmen may have visited the island ; and he showed, from the northern languages, that the final *d*, being mute, occasioned no difficulty. He supported his conjecture by adducing the authority of Doctor Barton, cited by an American correspondent of the editor of the *Antiquitates Americanæ*, as to the existence of rocks similar to that of Asonet, in the confines of the rivers Lata and Maragnon, in South America, on which, however, it would be premature to lay much stress. The probability of a Norse discovery of the West Indies he maintained from some par-

ticulars, connected with the residence of Ari Marson in Great Ireland, which was not far from Haiti.

The author further alluded to the similarity of the Irish boċ, and the Hebrew בת or בַּיִת, to *Bohio*, and hinted at the possible Irish or Jewish discovery of the island, should the former conjecture prove fallacious.

After recommending the *Antiquitates Americanæ* to the Icelandic student, as a most eligible text-book, and a complete contrast to the *Antiquitates Celto-Scandicæ*, the author concluded by expressing his belief, that a closer connexion with the antiquaries of Copenhagen, and a correspondence with the learned of America, might lead to such results as would shed additional lustre on the annals of the Academy.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Par MM. les Secretaires Perpetuels, Premier Semestre. Nos. 19, 20, 21. *Tables Alphabétiques.* Juillet—Decembre, 1837. Presented by the Academy.

Researches on Heat. Third Series. By James D. Forbes. Esq. F.R.SS. L. & E., F.G.S. (From the Transactions of the Royal Society of Edinburgh. Vol. 14.) Presented by the Author.

The Origin of the Egyptian Language, proved by the Analysis of that and the Hebrew, in an Introductory Essay. By Dr. L. Lowe. Presented by the Author.

Journal of the Statistical Society of London. No. 11. June, 1833. Presented by the Society.

June 25, 1838.

SIR WM. R. HAMILTON, A.M., President, in the Chair.

Dr. Apjohn made some remarks upon the subject of the Specific Heats of Gases.

The author stated that he had received, some months since, a memoir on the subject of the specific heats of gases, by M. Suerman, an eminent Dutch philosopher; upon examining which, he was not a little surprised to find that the method of the author was identically the same with that which he had himself employed, in a paper on the same subject, which has appeared in the last volume of the Transactions of the Academy. The following passage of M. Suerman's preface, however, completely removed his apprehensions of having been anticipated—"Tandem opus aggressus, et occupatus in idonea paranda supellectili diarium accepi Anglicum, quo in collegio, quod Dublini habetur, Chemiæ Professoris Apjohn continebatur disquisitio, ex eodem illa principio fluidorum elasticorum calorem specificum derivans. Primum,—quid sileam?—animo despondebam quum novitatis colorem quæ mihi præcipue arridebat, de meo evanescere viderem proposito."

This passage, he stated, he had been long anxious to bring before the Academy, lest, when Suerman's Thesis came to be noticed in the British journals, any Member of the Academy should suppose that he had borrowed his method from the learned Dutchman, and had done so without acknowledgment.

Dr. Apjohn then proceeded to remark upon some points, in reference to which he considered himself as having been misapprehended by M. Suerman. Thus he is represented in the following passage, as adopting an erroneous method of estimating the caloric of elasticity of aqueous vapour. "In computando vero formulam quam a claro Gay-

Lussac propositam vidimus, errorem effugere studuimus quem miror, etiam a viris celeberrimis commissum esse. Ponitur enim et in hac formula, et psychrometrica quam Dr. Apjohn proposuit, *l*, sive caloricum vaporis latens, terminus constans. At vero et theoria assumit, et experientia, quatenus adhuc innotuit, docet, non esse caloris quantitatem quam durante evaporatione vapor latens reddit, quacumque temperatura constantem, sed quantitatem calorici, quæ determinato vaporis pondere continetur, quod in maximo densitatis habetur."

Dr. Apjohn could not admit the applicability of this extract to himself, and in his vindication referred to the following passage, which occurs in his first paper on the Dew-point:—" It must of course be admitted, that the caloric of elasticity of vapour varies with the temperature, and that it is represented by 1129 only at the temperature of 50°, a point chosen by me as being nearly the mean temperature of Dublin. In strictness, the number employed should be $967 + 212 - t'$, but it would be easy to show that the uniform use of 1129 cannot give rise to any material error." The latter part of this passage, he observed, was intended only to apply to the meteorological use of his formula, and not at all to it when employed in the investigation of the question of gaseous specific heat. And had M. Suerman repeated the calculation of his experiments he would have found that he, Dr. A., had, while engaged with the specific heats of the gases, invariably employed the rigorous method of estimating the caloric of elasticity of vapour.

Dr. A. then drew attention to a tabular view of his results compared to those of Suerman, from which it appeared that there was a very close correspondence between them, a correspondence noticed and admitted by Suerman in the following passage: " siquidem ad diversissimum attendamus apparatum quo usus est, fatendum satis bene sibi convenire experimenta Dris. Apjohn, atque nostra. Utraque

vero multum distant ab experimentis doctorum Deloroche atque Berard, ad quæ nostra propius accedunt ratione fluidorum elasticorum elementariorum, experimenta D. Apjohn ratione aerum compositorum." The opinion, however, here expressed cannot, Dr. A. conceived, be considered as well sustained by the numbers adduced by Suerman. Thus, to give but a single example, the specific heat of hydrogen compared to that of an equal volume of air, as deduced by Suerman, was 1.3979, and as deduced, *according to Suerman*, by Dr. Apjohn. was 1,8948. Here is a material difference, quite beyond the probable errors of experiment, in explanation of which Dr. Apjohn stated, that 1,8948, and the other numbers attributed to him by Suerman, were, in point of fact, not those which flowed from his experiments; and at the same time admitted, that when they were so considered by Suerman, he, Dr. A. himself, was in some degree to blame. He had published his first results as the specific heats of equal weights, when they were in reality the specific heats of equal volumes; but in arriving at them it was necessary to be subjected to a particular correction, which, however, materially different in its influence upon them, according as it is applied to the case of equal volumes or of equal weights. Of these facts Suerman was not aware, and was thus prevented from perceiving that the very close correspondence which he recognized between the two series of results amounted to an almost perfect identity.

This identity, however, Dr. A. stated to be true of them when viewed relatively but not absolutely. The direct determinations by Suerman of the specific heat of air and of the different gases, were, Dr. A. alleged, in every instance greater than those at which he had arrived. This he attributed to three causes: 1st. To Suerman's estimating the caloric of elasticity of vapour higher than Dr. Apjohn had done. 2nd. To his employing the formula of Gay-Lussac, which differed from that which Dr. Apjohn had employed in

containing as a divisor, not p, but $p-f'$. But, 3rd, principally to Suerman having in no one instance obtained in his experiments depressions of such magnitude as those which he himself had observed. Dr. Apjohn did not explain the cause of this latter circumstance, as it would have required him to describe the very elaborate but rather complicated apparatus of M. Suerman, and to enter upon other details of a critical nature, which he conceived unsuited to a general meeting.

In conclusion, Dr. Apjohn stated, that M. Suerman had, in one direction, prosecuted the research in question further than he himself had done, having experimentally investigated the specific heat of air at a series of pressures less than that of the atmosphere. M. Poisson had given, in his *Traitè de Mecanique*, a formula for solving such problems, derived from analytical considerations, which however was found by Suerman to lead to numbers quite different from those to which his experiments had conducted.

To the preceding abstract of his observations, Dr. Apjohn is desirous of appending the following formulæ:—

$$a = \frac{f'e}{48d} \times \frac{30}{p} \qquad (1)$$

$$a = \frac{f'e}{48d} \times \frac{30}{p-f} \qquad (2)$$

In each of these a is the specific heat of the gas compared to that of an equal volume of atmospheric air, f' the tension of aqueous vapour of maximum elasticity, at the temperature shown by a wet thermometer placed in a current of such gas, and d the depression, or difference between the indications of the wet and a dry thermometer. Formula (1) is that which Dr. Apjohn communicated to the Academy in November, 1834, and which he employed in his researches on specific heats. Formula (2) is that which has been used by Suerman, and the investigation of which he attributes to Gay-Lussac. The former formula had been previously ar-

rived at by Ivory, (a circumstance to which Dr. Apjohn has alluded in his first paper on the Dew-point, without, however, having been at the time aware that Ivory's result and his own were perfectly identical,) and the same is probably true of Dr. August of Berlin, as may be collected from the following passage of Dr. Suerman's Thesis, p. 69:—

"Formulam psychrometricam ex theoria mixtionum aeris ac vaporis, anno 1834 deduxerat D. Apjohn, iisdem innisus principiis quibus Gay-Lussac de aere sicco, August et Ivory de humido, problema solverant, non tamen hos auctores secutus."

The Rev. Cæsar Otway read a paper "on the Ruined Abbeys in the Province of Connaught."

His object was to shew, in the first instance, the difference between the ancient Irish monastic establishments, and those subsequent to the Anglo-Norman conquest. He then called the attention of the Academy to the rapid demolition of these interesting religious structures by the people, who make them places of common and much prized sepulture, and (desiring to mark the places where their friends are buried) recklessly tear down the quoins, corbells, capitals of pillars, and all the elaborate ornaments they can lay their hands on, in order to answer the purpose of head stones.

Mr. Otway suggested the possibility of appointing persons who would act as conservators of these ancient edifices, and expressed his hope that the clergy might be made instrumental in putting a stop to the dilapidations he complained of. Mr. Otway alluded to the well known Fresco paintings on the walls of the choir of the Abbey of Knockmoy; and having stated that a rapid decay is in progress, whereby there is a likelihood of these interesting representations being speedily obliterated, he suggested that some artist (one who combined the execution of a good draughtsman with the taste and enterprize of an antiquarian) should be em-

oyed to copy them. Mr. Otway then alluded to the pro-
rty which one of the vaults at Knockmoy possesses of
eserving from corruption the bodies therein deposited,
id took occasion to animadvert on the careless and unbe-
ming way in which these depositories of the dead were
ft open to public intrusion. Having spoken of Rossreilly
bbey, near Headford, and exhibited a moss-covered skull
ken from these ruins, he next adverted to the Abbey of
ong; there also he shewed that the prejudices and super-
itions of the people are accelerating the demolition of the
uilding, and, as an instance, he stated how, not long ago,
he tomb alleged to be that of Roderick O'Connor, was
verwhelmed by a person who, in consequence of a dream,
ndermined the Abbey-wall to come at hidden treasure.
Ir. Otway concluded his paper with an account of Clare
sland and Abbey, the residence and place of interment of
he famous Grace O'Mealy.

Sir William Betham read a paper on two remarkable
ieces of antiquity preserved at Cong, in the County of
layo.

The first, he stated, is a cross, whose perpendicular shaft
six inches high, the arms one foot six inches, and the
hole five-eighths of an inch thick. Upon the edge is the
llowing inscription, intimating that this reliquary once
aclosed a portion of the true cross:

IAC. CRVCE. CRVX. TEGITVR. QVA. PASSVS. CONDITOR. ORBIS.

here are several other inscriptions in the Irish charac-
rs and language, of which Sir William also gave readings
nd translations; but these he has since withdrawn.

The second reliquary described in this paper, was known
opularly, as the author stated, by the name of the *Breast-
late*; but in his opinion it was undoubtedly a case for a
anuscript copy of the Gospels. Sir William exhibited a

odel of the front of this reliquary, with a drawing of ross, which he presented to the Museum of the Aca-

Ir. Petrie, by permission of the President, made some rks on Sir William Betham's paper, in which he pointed he original uses of these ancient reliquaries, and de-d at considerable length their history, gathered from the riptions found upon them, (of which he gave translations,) from the mention made of them in the Irish Annals and er records.

It was resolved, that Mr. Petrie be requested to prepare paper for the Transactions of the Academy on the history these reliquaries, in order that the valuable information e had collected respecting them might be preserved, and nade more generally known.

Dr. Coulter exhibited a specimen of the *Sphinx porcellus*, taken at Killiney, and stated that this rare insect had probably never before been found so far north in Ireland.

The reading of papers being concluded, the session was closed with the following

ADDRESS BY THE PRESIDENT.

The time has now arrived for terminating the present session; and it will, no doubt, be gratifying to you, as it is to me, that our closing act should be the public presentation of a Medal to one of our most distinguished Members; that Medal being the first which has been awarded by your Council in the exercise of the new and fuller power confided by you lately to them, and in execution of the plan which was announced to you at the time when you gave them that enlarged discretion, with respect to the bestowal of honorary rewards.

That plan, as you may remember, differs little from the scheme suggested by me in the inaugural address which I had the honor

to deliver on the occasion of first taking the chair of this Academy: the only difference, indeed, so far as science is concerned, being the subsequent adoption of a suggestion of Professor Lloyd, repecting a change of distribution of those subjects which were included by me under the two great heads of Physics and Physiology, but by him under those of Experimental and Observational Science, or Physics and Natural History. The time for acting upon this modification has not, however, as yet arrived; and before the suffrages of your Council were collected, at its last meeting, on the question of the absolute and relative merits of the various communications which have lately been made to our Transactions, it was resolved to postpone, till after the recess, the consideration of all scientific or other awards, except only that which should be made for the most important paper in pure or mixed mathematics, communicated during the three years which ended in March 1837, and already actually printed. The papers coming within this definition were few; the authors of them were only two, Professor Mac Cullagh and myself. The decision, which in theory is a decision of the President and Council, and which did in fact receive my cordial and previously expressed concurence, was in favour of Mr. Mac Cullagh's paper "On the Laws of Crystalline Reflexion and Refraction," contained in the just published part of the eighteenth volume of the Transactions of this Academy.

It may happen that upon future occasions of this sort, if it shall again become my duty to present from this Chair those Medals which may hereafter be awarded, for papers of other triennial cycles, and upon other subjects, I may not think it necessary or expedient to occupy your time by any but the briefest statement of the grounds on which those future awards may have been made. But on the present occasion, which is (to me at least, and in relation to our new plan) the first occasion of its kind; while the subject is one of a class to which my own inquiries have been much directed, and upon which, therefore, I may speak with a less risk of impropriety than upon many others; and while we, as an Academy, by extra hours and extra nights of attendance, during that busy session which is now about to close, have earned for ourselves a little leisure, on this last night of meeting, without interfering (as

we hope) with the rights, or even with the convenience of authors; I think myself allowed to enter more at large into the merits of the award, and to lay before you some of the thoughts which the perusal of the present prize essay has suggested to my own mind.

When ordinary light is reflected at the common boundary of two transparent and uncrystallized media, as when we see (for example) the reflexion of the sun in water, the reflected light differs from the incident in both direction and intensity, according to laws which were known to Euclid in so far as they regard *direction*, but of which the discovery, in so far as *intensity* is concerned, was reserved for the sagacity of Fresnel. In general, the laws which regulate the changes of the direction of light have been found easier of discovery than those which regulate its changes of intensity; the laws of the reflexions and refractions of the lines along which light is propagated, than the laws of the accompanying determinations or alterations of its planes of polarisation; or, to express the same distinction in the language of the theory of undulations, it has been found easier to assign the form of the waves which spread from any origin of disturbance through any given portion of the elastic luminiferous ether, than to assign the directions and relative magnitudes of the vibrations which constitute those waves, and the laws which regulate the changes of such vibrations, in the passage from one medium to another.

The laws which regulate such *changes of vibration*, produced by reflexion and refraction, at the boundaries of crystallized media, have been the special object of Mr. Mac Cullagh's investigations, in the paper now before us. But in investigating them, he has been obliged to consider also the laws which regulate the vibrations of the ether, in the *interior* of a crystallized body, and not at its *surface* only; the laws of the *propagation* as well as those of the *reflexion* and *refraction* of light. His researches are therefore connected intimately with a wide range of optical phenomena; and the hypotheses on which his formulæ are founded, and which seem to have their own correctness proved by the experiments of many kinds with which they have been successfully compared, though liable, of course, like every physical induction, to be modified in some degree by future observation, appear to be en-

titled to assume henceforth a very high rank among the principles of physical optics.

The method which Mr. Mac Cullagh has adopted may be said to be in general the method of *mathematical induction*, as distinguished from *dynamical deduction*. He has not sought to deduce, from any pre-supposed attractions or repulsions, and arrangements of the molecules of the ether, any conclusions respecting the vibrations in the interior or at the boundaries of a medium, as necessary consequences of those dynamical principles or assumptions. But he has sought to gather from phenomena a system of mathematical laws by which those phenomena might be expressed and grouped together, be conceived in connexion with each other, and receive an inductive unity. He has sought to arrive at laws which might bear somewhat the same relation to the optical observations already made, as the laws of Kepler did to the astronomical observations of his predecessor Tycho Brahe, without seeking yet to deduce these laws, as Newton did the laws of Kepler, from any higher and dynamic principle. And though, no doubt, it is to such deduction that science must continually tend; and though, in optics, some progress has been actually made, by Cauchy and by others, to a dynamical theory of light, as a system of vibrations regulated by forces of attraction and repulsion; yet it may well be judged a matter of congratulation when minds are found endowed with talents so high as those which Mr. Mac Cullagh possesses, and willing to apply them to the preparatory but important task of discovering, from the phenomena themselves, the mathematical laws which connect and represent those phenomena, and are in a manner intermediate between facts and principles, between appearances and causes.

It was thus, that, in a former paper, Mr. Mac Cullagh proposed, as mathematical expressions for the phenomena of Quartz, a system of differential equations, which are indeed simple in themselves, and seem to agree well with observation, but have not yet been shewn to be consistent with dynamic views. And in that later memoir for which the present prize is awarded, he has, in like manner, adopted some hypotheses, and rejected others, without apparently regarding whether and how far it may seem possible

at present to reconcile such adoption or such rejection with received opinions respecting the mechanism of light; exhibiting thus, a kind of intellectual courage, in admiring which I am fortified by the opinion of Sir John Herschel, who lately, in a conversation and a letter, expressed himself thus to me: "The perusal of Mr. Mac Cullagh's paper on the Laws of Reflexion and Polarisation in Crystals, has, although cursory, produced a very strong impression on my mind that the theory of light is on the eve of some considerable improvement, and that by abandoning for a while the *à priori* or deductive path, and searching among phenomena for laws simple in their geometrical enunciation, and of more or less wide applicability, *without (for a while) much troubling ourselves how far those laws may be in apparent accordance with any preconceived notions, or even with what we are used to consider as general principles in dynamics*, it may be possible to unite scattered fragments of knowledge into such groups and masses as shall afford glimpses of their fitness to combine into a regular edifice."

The hypotheses which are the bases of Mr. Mac Cullagh's theory of Crystalline Reflexion and Refraction are the following. He supposes that the form of the wave surface in a doubly-refracting crystal is that which was assigned by Fresnel, and that the vibrations are tangential to this surface, but that they are perpendicular to the ray, and consequently *parallel* to the plane of polarisation; whereas Fresnel supposed them to coincide with the projection of the ray upon the wave, and consequently to be perpendicular to the plane of polarisation. Professor Mac Cullagh supposes also, with Fresnel, that the *vis viva* is preserved, or in other words, that the reflected and refracted lights are together equal to the incident; but in applying this principle to investigate the refracted vibrations, he supposes, in opposition to Fresnel, that the density of the ether is *not changed* in passing from one body to another. And he supposes, finally, that *the vibrations in two contiguous transparent media are equivalent;* or, in other words, that the resultant of the incident and reflected vibrations is the same, both in length and direction, as the resultant of the refracted vibrations; whereas Fresnel had

supposed only that the vibrations parallel to the separating surface, but not that the vibrations perpendicular to the same surface were equivalent.

And here I may be permitted to state, what indeed cannot fail to be remembered by many here, that when the British Association for the Advancement of Science met in this city, about three years ago, (in August, 1835), a communication was made by Mr. Mac Cullagh to the Mathematical and Physical section, "on the Laws of Reflexion and Refraction at the Surface of Crystals," which embodied nearly all the principles or hypotheses that I have now recited, and of which an abstract was printed in the London and Edinburgh Philosophical Magazine for October, 1835, having indeed been published even earlier (in September, 1835) by Mr. Hardy here. The only supposition, which was not either formally stated or clearly indicated in this abstract, was that of the preservation of the *vis viva;* instead of which principle of Fresnel, Mr. Mac Cullagh was, at one time, inclined to employ a relation between pressures, proposed by M. Cauchy. Since, therefore, the leading principles of the new theory of Reflexion and Refraction were all made known by Mr. Mac Cullagh so early as the August of 1835, were printed in Dublin in the September of that year, and in London in the October following, it will not, perhaps, be attributed solely to national partiality if we claim for him the priority of discovery on this curious and important question, notwithstanding that a very valuable and elaborate memoir on the same subject, embodying the same results, was communicated, in December, 1835, to the Academy of Sciences at Berlin, by M. Neumann, and was published in 1837, before the publication (though after the reading) of that essay of Mr. Mac Cullagh, to which the present prize is awarded.

It is, however, an interesting circumstance, and one which is adapted to increase our confidence in these new laws of light, that they should have been independently and almost simultaneously discovered in these and in foreign countries; and it will not, I trust, be supposed that I desire to depreciate M. Neumann's admirable essay, if having recalled some facts and dates which bear upon the question of priority, I proceed to point out a few of the features

of Mr. Mac Cullagh's briefer paper, which have appeared to me to deserve a peculiar and special attention. I mean the geometrical elegance of the principal enunciations, and the philosophical character of the interspersed remarks.

As a specimen of the former, I shall select the theorem of the *polar plane*. When light in air is incident on a doubly-refracting crystal, it may be polarised in such a plane, that one of the two refracted rays shall disappear; and then the one refracted vibration which corresponds to the one remaining refracted ray, must (by the hypotheses or laws already mentioned) be the resultant of the one incident and one reflected vibration; and consequently these three vibrations must be contained in one common plane, which plane it is therefore an object of interest to assign a simple rule for constructing. In fact, the refracted vibration is known, in direction, from the laws of propagation of light in the crystal, and the hypotheses already mentioned; if, then, we know how to draw through its direction the plane just now referred to, we should only have to examine in what lines this plane intersected the incident and reflected waves, in order to obtain the direction of the incident and reflected vibrations, and afterwards (by the rules of statical composition) the relative magnitudes of all the three vibrations, or the relative intensities of the incident, reflected, and refracted lights. Now Mr. Mac Cullagh shows, that the desired construction can be deduced from the properties of the doubly refracting medium or wave, as follows: Let OT, OP represent in length and in direction the velocity of the refracted ray, and the slowness of the refracted wave; so that, by what has been before supposed, the refracted vibration OV is perpendicular to the plane TOP; then, if a plane be drawn *through the vibration* OV, *parallel to the line* TP, this plane, which Mr. Mac Cullagh calls the *polar plane* of the ray OT, will be the plane desired; that is, it will contain the incident and the reflected vibrations, if these be uniradial, or, in other words, if they have such directions, or correspond to such polarisations, as to cause one of the two refracted rays in the crystal to disappear.

Many elegant geometrical corollaries are drawn, in the Essay, from this theorem of the polar plane; but I shall only mention one,

(which includes, as a particular case, the remarkable law for determining the angle of polarisation of light reflected at the surface of an ordinary medium, discovered by Sir David Brewster,) namely, that when the light reflected from the surface of a doubly refracting crystal is completely polarised, or, in other words, when the reflected vibration has a determined direction, independent of the direction of the incident vibration, then *the reflected ray is perpendicular to the intersection of the polar planes of the two different refracted rays.*

In this and other applications of the theorem of the polar plane to the case where the incident light is polarised so as to undergo a double refraction, the obvious manner of proceeding is to decompose its *one biradial* vibration into *two uniradial* vibrations, and to treat these separately, by applying to each the construction above described. Yet Mr. Mac Cullagh remarks, that it requires proof that the reflected and refracted intensities, thus determined, will have their sum exactly equal to the intensity of the incident light; or, in other words, that the law of the *vis viva* will hold good for the resultant vibrations, though we know, by the construction, that it holds good for each system of uniradial components taken separately. In fact, if the two separate incident vibrations, which correspond to the two separate refracted vibrations, be inclined at an acute angle to each other, they will generate by their superposition (according to the law of interference) a compound incident light, of which the intensity exceeds, by a determined amount, the sum of the two separate or component intensities; and it requires proof that the two separate reflected vibrations will in like manner be inclined to each other at that precise acuteness of angle which will allow the intensity of the compound reflected light to exceed, by precisely the same determined amount, the sum of the two separate intensities, corresponding to the two separate reflected vibrations: (or that the same sort of equality of differences between incident and reflected resultants and sums will take place, when the angles are obtuse and not acute;) the two refracted vibrations being not in general (in either case) superposed upon each other. Professor Mac Cullagh has arrived at an equation of condition, as necessary for the foregoing agreement, which expresses a property of the laws of propagation de-

duced from the laws of reflexion and refraction, however singular it may appear that the latter laws should give any information respecting the former; and he states that he has found this equation to express rigorously a property of Fresnel's wave. His demonstration of this latter property having not yet been published, I have been induced to investigate one for myself; and have thus been conducted to a construction of the condition in question, so simple that it may perhaps be mentioned here. Let R and W denote the planes VOT and VOP in the figure before referred to, which may also be called the planes of ray-polarisation and of wave-polarisation, for the ray OT, or for the corresponding wave; and let P′, T′, R′, W′ be analogous to P, T, R, W, but referred to any other ray or wave; then the following is the relation to be satisfied:

$$\mathrm{OT}\,.\,\mathrm{OP}'.\,\cos \mathrm{RW}' = \mathrm{OT}'.\,\mathrm{OP}\,.\cos \mathrm{R}'\mathrm{W};$$

RW′ and R′W denoting here diedral angles. Under this form, it is easily proved that Fresnel's wave surface possesses rigorously the property in question. Mr. Mac Cullagh's equation has been otherwise obtained by M. Neumann, namely, as a condition for the possibility of depressing the equation of the *vis viva* to the first from the second degree.

On this and many other points of the investigation, Mr. Mac Cullagh (as I have already said) has thrown out many interesting and philosophical remarks; for instance, that the perfect adaptation which thus appears to exist between the laws of the propagation and those of the reflexion and refraction of light, is a strong indication that these two sets of laws are derived from some one common source, in other and more intimate laws not yet discovered; and that it is allowed to hope that the next step in physical optics will lead us to those higher and more elementary principles by which the laws of reflexion and propagation are linked together as parts of the same system. His remarks on the probable connexion between the theories of metallic and crystalline reflexion, and on the hopefulness of ascending to a true theory of light by the method of mathematical induction from phenomena, (exemplified, as has been seen, in his own papers,) rather than by attempting prematurely to make deductions from dynamical principles, are also well worthy of attention, though my own habits of thought

lead me to feel an even stronger interest in dynamic and deductive researches.

But I have suffered myself to speak at greater length than has been usually occupied by others before, or is likely to be occupied by me hereafter on other similar occasions, and certainly at greater length than was required to justify the award of your Council. The reasons which I pleaded at the commencement of this address may, perhaps, serve partly as my excuse for having occupied your time so long; and some additional indulgence may have been thought due by those who remember that many years ago, both here and elsewhere, in public and in private, I expressed strongly my admiration of the talents of him to whom I have now the gratifying office of presenting this first public mark of honour from his scientific brethren and cotemporaries.

[*The President then, delivering the Medal to Professor Mac Cullagh, addressed him as follows:—*]

Professor Mac Cullagh,

I present to you this medal, awarded to you by the President and Council of the Royal Irish Academy. Accept it as a mark of the interest and intellectual sympathy with which we regard your researches; of the pleasure with which we have received the communications wherewith you have already favoured us; and of our hope to be favoured with other communications hereafter. And when your genius shall have filled a wider sphere of fame than that which (though already recognized, and not here only) it has yet come to occupy, let *this* attest, that minds were found which could appreciate and admire you early in this your native country.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Par MM. les Secretaires Perpetuels. Premier Semestre. No. 22, 1838. Tables Alphabetiques, Juillet, Decembre, 1837. Presented by the Academy.

Journal of the Franklin Institute of the State of Pensylvania, and Mechanics' Register. Edited by Thomas P. Jones,

M. D. New Series, Vol. XX. Presented by the Franklin Institute.

Proceedings of the Numismatic Society, 1836-37. Presented by the Society.

A Philosophical and Statistical History of the Inventions and Customs of Ancient and Modern Nations, in the Manufacture and Use of Inebriating Liquors. By Samuel Morewood, Esq. Presented by the Author.

Two Spear Heads. Presented by Sir William Betham.

A Model in Wax of the ancient Reliquary described in Sir William Betham's Paper as "the Breastplate of Cong," with a Drawing of the Crozier. Presented by the same.

PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY,

FOR THE YEAR 1838–9.

PART III.

DUBLIN:
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M.DCCC.XXXIX.

GEOLOGICAL
DUBLIN
SOCIETY.

THE

ROYAL IRISH ACADEMY.

MARCH 16, 1839.

PATRONESS:

HER MOST SACRED MAJESTY THE QUEEN.

VISITOR:

HIS EXCELLENCY THE LORD LIEUTENANT OF IRELAND.

PRESIDENT—SIR WILLIAM ROWAN HAMILTON, A. M.

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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1838—1839. No. 14.

November 12.

SIR WM. R. HAMILTON, President, in the Chair.

Rev. Matthew Horgan; George Alexander Frazer, Esq.; Sir Joseph O'Halloran, K. C. B.; and Halliday Bruce, Esq., were elected Members.

Miss Caroline Herschel was elected an Honorary Member.

Sir W. Betham read a paper in answer to certain objections made to the statements in his former papers on Etruscan Mirrors, and on the fifth Eugubian Table.

Professor Kane read a note on the Theory of the Ethers.

In a late number of the *Annalen der Pharmacie*, Professor Liebig asserted that Dr. Kane should relinquish his claim to the discovery of the Ethyl Theory, in favour of Berzelius, on two grounds,—first, that Dr. Kane's view was not originally more definite than that of Dumas, and did not possess the completeness in which it was brought forward by Berzelius; and second, that Dr. Kane had taken no part in the subsequent discussions about the theory, had on many occasions shown indifference towards its establishment, and fluctuated between the old and new views. In the notice submitted to the Academy, Dr. Kane undertook to show the incorrectness of Professor Liebig's observations.

The idea thrown out by Dumas, to which Liebig alludes, was, that ether might be considered as a base, and the acid ethers as salts of that base. This idea Dumas himself, on further consideration, rejected, and assumed ether to be a hydrate of olefiant gas, which he made the basic element in the acid ethers, thus rejecting the form C_4H_5O + acid, and taking $HO + (C_4H_4$ + acid,) as the foundation of all his subsequent researches. The sense in which Dumas considered ether as a base, was the same as that in which chemists regard the vegetable alcalies as bases,—that is, bodies which neutralize acids and form salts,—without seeking more profoundly into their constitution, or involving any hypothesis; whilst the essence of the views propounded by Dr. Kane and Berzelius consisted in considering ether as the oxide of a peculiar compound radical (*Ethyl. Ethereum*) C_4H_5. resembling the ammonium of the ammonia series,—an idea which Dumas never thought of proposing at all, and indeed one which the state of science, at the time of his researches on the ethers, could scarcely permit him to conceive.

So far from the Ether Theory being less complete, as promulgated by Dr. Kane, than when proposed by Berzelius, Dr. Kane asserted the reverse to be really the case, for it was only after Liebig himself had modified Berzelius' views, that the continental theory became identical with that previously brought forward in Dublin,—Berzelius having destroyed the unity of the theory by making alcohol $C_2H_3 + O$, which we now know to be a totally different substance, and Liebig having shown that it should be considered, $C_4H_5O + HO$, which it had always been considered in the theory proposed by Dr. Kane. Thus in the only point in which the theories differed, the form of Berzelius was the less complete of the two.

Dr. Kane has, since the promulgation of that theory, been induced, from the results of researches in other departments, to suspend his implicit belief in its sufficiency. Having ad-

vanced in the history of the ammoniacal combinations an important stage beyond the ammonium theory of Berzelius, it becomes of great interest that the nature of the ethers should be investigated with the aid of the lights furnished by this novel analogical point of view. This Dr. Kane purposes to do; and in the mean time, while he looks upon the Ethyl Theory as the most consonant to all facts at present known, and while, consequently, he will use on ordinary occasions its language and formulæ, he holds himself free of all implicit belief in any theories, which might only serve to embarrass him in his future investigations.

Dr. Kane grants fully to the continental chemists the honour of having developed the detailed evidence for the truth of the Ethyl Theory, so far as it has been proved, and claims no share whatsoever in that meritorious work. But he cannot abandon his claim to having been the first to suggest the theory; and he affirms that in the form in which he brought it forward, it was not merely more complete than that ofDumas, but even than that of Berzelius, and in fact identical with that now held by Liebig, Berzelius, and most of the continental and British chemists.

DONATIONS.

Transactions of the Royal Academy of Sciences of Copenhagen, Vols. I to VII. Presented by the Society.

Mémoires de l'Academie Imperiale des Sciences de St. Pétersbourg. 6me Serie. *Sciences Mathematiques, Physiques et Naturelles*. 6 Tomes. Presented by the Academy.

Mémoires de l'Académie Impériale des Sciences de St. Pétersbourg. 6me Serie. *Sciences Politiques, Histoire, Philologie*. 3 Tomes. Presented by the Academy.

Mémoires présentés a l'Académie Impériale des Sciences de St. Pétersbourg par divers Savans, et lus dans ses Assemblées. 3 Tomes, et 1re et 2me Livraisons du Tome Quatrième Presented by the same.

Recueil des Actes de la Séance Publique de l'Académie Impériale des Sciences de St. Pétersburg, tenue le 29 Décembre, 1837. Presented by the same.

Comptes Rendus Hebdomadaires des Seances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. No. 23, 1838; premier Semestre. Nos. 1—16; second Semestre. Presented by the Academy.

Memoires de la Société Geologique de France. Tome Troisieme. Premiere Partie. Presented by the Society.

Bulletin de la Société Géologique de France. Tome IX. Feuilles 6—19. Presented by the Society.

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tome VIII. 1re partie. Presented by the Society.

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre, 1836. Presented by the Academy.

Bericht über die zur Bekanntmachung geeigneten Verhanlungen der Königl. Preuss. Akademie der Wissenschaften zu Berlin. Aus dem Jahre, 1837. Presented by the same.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Konigl. Preuss. Akademie der Wissenschaften zu Berlin aus dem Jahre, 1838. Presented by the same.

Discurso Lido em 15 *de Maio de* 1838, *na Sessão Publica da Academia Real das Sciencias de Lisboa.* Por Joaquim José da Costa de Macedo. Presented by the Chevalier de Macedo.

Transactions of the American Philosophical Society. Vol. VI. Part I. New Series. Presented by the Society.

Journal of the Franklin Institute of the State of Pensylvania. New Series. Vol. XXI. Presented by the Franklin Institute.

Archæologia; or Miscellaneous Tracts relating to Antiquity. Published by the Society of Antiquaries of London. Vol. XXVII. Presented by the Society.

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reflexion et de refraction que j'avais eues l'honneur de présenter à l'Academie des Sciences de Berlin en 1835.

Vous voyez par tout ceci, Monsieur, que dès 1833 j'ai été en pleine possession de la methode, et que dès le commencement de 1834 j'ai été en pleine possession des résultats qu'elle fournit, que dans ce même tems j'ai envoyé un abrégé contenant ces resultats et lu en manuscrit par plusieurs savans bien connus à Mr. le redacteur des Annales de Physique et Chimie pour le publier dans ce recueil, et qu'à la fin de 1835, j'ai présenté l'ouvrage complet à present imprimé à l'Academie de Berlin;—vous voyez en même tems, que Mr. Mac Cullagh ayant communiqué à l'Association Britanique en 1835 des lois de réflexion et de refractiou crystallin, ces lois ont été demontrées être fautives par Mr. Seebeck in 1836, et que Mr. Mac Cullagh n'est parvenu en 1837 aux vraies lois qu' après avoir pris connaissance du fondement de ma méthode, et s'en être servi.

De tout cela resulte, Monsieur, que la priorité de la découverte des lois de réflèxion et réfraction par des crystaux n'est pas douteuse, et qu'il n'y a pas de simultaneité entre mes travaux et ceux de Mr. Mac Cullagh, dont du reste personne ne peut estimer plus que moi le talent distingué.

Daignez, Monsieur, agréer les assurances de la plus haute consideration avec laquelle je suis, &c.

F. E. NEUMANN.

Königsberg, 5 *Octobre*, 1838.

When this letter was read, Professor Mac Cullagh requested permission to make a few remarks. After expressing much regret, that his researches in the theory of light should have clashed with those of any other person, (though in the present state of science such collisions were perhaps inevitable,) he proceeded to say, that he did not think it necessary to detain the Academy with a formal reply to the communication which had just been read; it would be sufficient for him to observe, in general, that the facts brought forward by the writer, with reference to the history of his own investigations, were all, without exception, of a private

nature, not one of them being taken from any published document; that the *first* document of the kind, which professed to give any account of M. Neumann's "method," or any statement of the principles employed in it, appeared in the Annals of Poggendorf, (vol. xl. p. 497,) some months after Mr. Mac Cullagh had published his *last* paper on the subject in the Philosophical Magazine, (vol. x. p. 43,) and even after that paper had been noticed in the aforesaid Annals, (vol. xl. p. 462); that M. Neumann's Memoir in the Berlin Transactions was not published until a later period; that, therefore, there could be no question about priority of publication; and that, consequently, if it were to be imagined, for a moment, that either author had borrowed from the other, the presumption must necessarily be against M. Neumann. With respect to M. Seebeck's note, it would be enough to state, that M. Neumann is not mentioned there at all; that the principles there given by M. Seebeck are not adequate to the general solution of the problem; and that such of them as differ from those of Fresnel, had been previously published by Mr. Mac Cullagh. It was clear, therefore, that Mr. Mac Cullagh owed nothing on the score of theory to any one but Fresnel. He had, indeed, made one alteration in his theory as it originally stood; for he had at first rejected Fresnel's law of the *vis viva*, and had been obliged to restore it afterwards, in order to account for certain experiments of M. Seebeck, which M. Seebeck himself, from want of sufficient principles, had not attempted to account for; but the real service which M. Seebeck had rendered him, and for which he had frequently acknowledged his obligations, was the communication of these experiments, and not any suggestion of the law of *vis viva*, which he knew well enough before. In all this, however, it was plain that M. Neumann had no concern, unless he chose to say, that he had appropriated to himself Fresnel's law of the *vis viva*, that he had determined to regard it as the foundation of his

method, (*le fondement de sa méthode,*) and that thenceforward no one else (however ignorant of such appropriation) could have any right to use it.

Having thus endeavoured to prove his claim to priority of publication, and to establish the independence of his own researches, which was all that was necessary for self defence, Mr. Mac Cullagh concluded by saying, that he would there drop the argument, without discussing his claim to priority in the abstract, as he had an objection to disputes of such a kind, and did not wish to pursue them any farther than he was compelled to do. But if any one thought it worth while to examine the merits of this second question, he would find the circumstances relating to it very fully and clearly stated in the last number of the Proceedings of the Academy, (page 217 of the present volume,) and would thence be enabled to form a judgment for himself.

Mr. Downes read an Extract of a Letter from Professor Rafn, of Copenhagen, containing the following queries, addressed to the Academy, for the purpose of procuring information available for the *Historical Monuments of Greenland*, a work projected by the Society of Northern Antiquaries:

"1. Are there any accounts that the District of Majo [Mayo] in Ireland, or its north-western section, was at the close of the fourteenth century independent, or had separate princes?

2. "Where did these princes reside?

3. "We should like to have a catalogue of the princes of this district from the earliest times.

4. "What harbours are there between Broad Haven and the bay of Killala?

5. "What is the right name of the north point of the district Majo? (Cape Binir or Cape Calliugh?)

6. "Is this headland high, and visible from a great distance?

7. "Are there dangerous shallows off this Cape, and are they near the shore, or at some distance?

8. "The same questions are proposed in reference to the cape, or headland Downpatrick [county Mayo]?"

In addition to these queries, written originally in English, Mr. Downes communicated the substance of a passage in the Danish part of the letter, of which the following is a translation:

"Professor Magnusen, and many other distinguished Icelanders, are descended from various Irish and Scotch princes and kings, as will be fully elucidated in the *British and Irish Antiquities*; but a detailed account of the genealogies requires much and minute preparatory research. We must try to excite increased interest, otherwise our great work will never be published: it would extend to four such volumes as the *American Antiquities*. Is there any prospect of an adequate subscription towards the completion of the work, or must it be given up altogether?"

Mr. Downes suggested to the Academy the propriety of contributing liberally to the furtherance of the two above-mentioned works projected by the Society of Northern Antiquaries, as likely to be highly interesting to the Academy and to Ireland in general.

Dr. Barker exhibited to the meeting the production of carbonic acid in the *solid* state, as effected by compression and refrigeration, according to the method discovered by Thillorier, and with the simplified apparatus of Mr. Addams.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. Second Semestre. Nos. 17, 18. Presented by the Academy.

Memoires Couronnès par l'Academie Royale des Sciences et Belles-lettres de Bruxelles. Tome 12 and 13. Presented by the Academy.

Bulletin de l'Academie Royale des Sciences et Belles-lettres de Bruxelles. Années 1836 et 1837. Année 1838, (Nos. 1—8.) Presented by the Academy.

Annuaire de l'Academie Royale des Sciences et Belles-lettres de Bruxelles. Troisième et Quatrieme Année. Par A. Quetelet. Presented by the Author.

Annuaire de l'Observatoire de Bruxelles, pour l'An. 1838. Par le Directeur, A. Quetelet. Presented by the Author.

Sur la Latitude de l'Observatoire de Bruxelles. Par A. Quetelet. Presented by the same.

De l'Influence des Saisons sur la Mortalité aux différens Ages, dans Belgique. Par A. Quetelet. Presented by the Author.

Rapport sur les Observations des Marées, faites en 1835, *en differens Points des Côtes de Belgique.* Par Messieurs Belsaire et Quetelet, Rapporteurs. Presented by the same.

Proceedings of the Royal Society. No. 27. Presented by the Society.

The American Almanac and Repository of Useful Knowledge. For the Year 1839. Presented by the American Philosophical Society.

Remarks on the Classification of the different Branches of human Knowledge. By J. W. Lubbock, Esq., F.R.S. &c. Presented by the Author.

The India Review, and Journal of Foreign Science and the Arts. Vol. I. Edited by Frederick Corbyn, Esq. Presented by the Editor.

Reduction of the Observations made by Bradley, at Kew, and Wanstead, to determine the quantities of Aberration and Nutation. By Dr. Busch, Assistant Astronomer at the Royal Observatory of Königsberg. Presented by the Author.

December 10.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

John Herbert Orpen Esq. was elected a member.

Professor Mac Cullagh presented two papyri, the gift of George James Knox, Esq. by whom they were lately brought from Upper Egypt.

RESOLVED,—That the Council be directed to take the proper steps to unrol and preserve the papyri.

Mr. Ball read a paper entitled "Description of the Cydippe pomiformis, Patterson, (Beröe Ovatus, Flem.,) with notice of an apparently undescribed Species of Bolina, also found on the Coast of Ireland." By Robert Patterson, Esq., Member of the Natural History Society of Belfast.

The author referred to a paper of his published in the Edinburgh New Philosophical Journal for January 1836, giving some account of a tentaculated Beröe, taken in abundance by him at Larne Lough, County of Antrim, in the Spring of 1835. He then noticed the occurrence, on different occasions in 1836-7, of a Beröe, exhibiting a peculiar ramiform arrangement of whitish internal vessels, branching off from near the lower part of the stomach to the several bands of cilia; and detailed the observations by which he was enabled to identify this with the Beröe described in Mem. Wer. Soc., vol. iii. p. 400, by Fleming,—the tentacula having escaped the notice of that writer, from the specimen he examined having been in an exhausted state when these organs were retracted within the body. The presence of the tentacula removes the animal from the Genus Beröe of Fleming, to the Pleurobrachia of the same author (Cydippe Eschs,) and as the specific name Ovata, under which it was described in the Hist. of Brit. Animals, has been applied to

a different species, Mr. Patterson proposed that it should be designated as the Cydippe pomiformis.

The disappearance of the internal ramiform vessels was next noticed, and the steps by which the writer was enabled to ascertain that the species now brought forward was identical with that described by him in 1835; and consequently, that a Beröe, of the occurrence of which we have no record, except of one individual taken in 1820, was abundant on the Irish coast. Particular reference was made to Doctor Grant's paper (Zool. Trans. vol. i. p. 9,) on B. Pilens, with a view to indicate the several points of agreement and of difference between these, the only two British species of tentaculated Beröes. The structure of the Cilia, the aqueous currents at their base, the position and structure of the tentacula, the food of the Beröe, its vitality, consistency, want of phosphorescence, movements, iridescence, times of appearance, and diffusion round the coast, formed the principal topics embraced in the remainder of the paper.

The occurrence of the Bolina on different parts of the Irish coast was mentioned, principally for the purpose of enabling Mr. Patterson to refer to some points of its economy for comparison and contrast with the C. pomiformis. He reserved a detailed account of various particulars concerning it to a future opportunity, when he expected to be able to exhibit additional figures taken from living specimens, and more accurately delineated than those at present brought forward. Meantime, as the animal differed from the two species of Bolina described by Mutius, he proposed to name it provisionally Bolina Hibernica.

The President read a paper by the Rev. Dr. Robinson "on the Longitude of the Armagh Observatory, given by Chronometers and other Methods."

After remarking the inconveniences, or uncertainties, which to a certain extent attend the methods of determining

differences of longitudes by signals, geodetic measures, occultations, and transits, the author passes to the most direct and natural method, by transport of chronometers. He says, "the determination by chronometers depends on the perfection of these machines, and in particular on their rate being unchanged by the agitation of a long journey. This, strictly speaking, is never the case, though it is sometimes very nearly accomplished, and its effect will disappear from the mean of the results obtained in going and returning, if the circumstances of the two journeys are nearly similar. Unfortunately it rarely happens, that an astronomer has the power of making these experiments on a sufficient scale: but such an opportunity seemed to Sir William Hamilton, and myself, to present itself in consequence of Mr. Dent's chronometric visit to Paris, and the yet more remarkable notice, read at the Newcastle Meeting of the British Association, of the chronometric longitude of Sir Thomas Brisbane's Observatory. Mr. Dent not merely promised us every assistance, but when, having obtained the consent of the authorities of our respective observatories, we proceeded to make the necessary pecuniary arrangements, he treated the matter as one of science, not of commerce, and not only took on himself the expense and risk of the journey, but came in person."

Dr. Robinson proceeds to mention the particulars of the journey, and of the comparisons which were made with the fifteen chronometers which Mr. Dent brought with him. Their rates and errors, as compared with Greenwich time, had been determined, before starting, for the epoch of the 20th of September, 1838; they were compared with Dublin time, in the observatory of Trinity College, on the 22nd of that month, and with Armagh time on the 23rd and 24th; were again examined in Dublin, on the 25th, and in Greenwich, on the 27th of September.

The fundamental formulæ employed by Dr. Robinson are the following:

$$\text{L}=\text{E}-\text{W}+\text{RI};$$
$$\text{L}=\text{E}'-\text{W}'-\text{R}'\text{I}';$$

L being the difference of longitudes between an eastern and a western station; E the correction of a watch when leaving the eastern, and W the correction when arriving at the western, while W′ and E′ are the corrections when leaving the latter and returning to the former respectively; I, I′, the intervals of time expended in thus going and returning; and R, R′, the losing rates corresponding. By supposing $\text{R}'=\text{R}$, he obtains what he considers the true *travelling rate*, namely,

$$\text{R}=\frac{(\text{E}'-\text{W}')-(\text{E}-\text{W})}{\text{I}+\text{I}'};$$

and the resulting longitude

$$\text{L}=\tfrac{1}{2}\left\{\text{E}'-\text{W}'+\text{E}-\text{W}+\text{R}(\text{I}-\text{I}')\right\}.$$

The errors are then examined to which these determinations are liable, and the numerical elements are given, from which are deduced fifteen values for the longitude of Armagh, varying between the extremes $26^m\ 34^s, 67$, and $26^m\ 36^s, 32$, and giving as their general mean, $26^m\ 35^s, 44$, with a probable error less than $0^s, 1$.

Eclipses and occultations had given $26^m\ 35^s, 47$; lunar transits, $26^m\ 35^s, 64$; and a few comparisons, made under unfavourable circumstances with a single pocket watch, constructed by the late Mr. Sharp, had appeared to give $26^m\ 35^s, 09$. On the whole, Dr. Robinson is not inclined to change the quantity which he gave some years ago to Mr. Stratford, for insertion in the Nautical Almanac, namely,

$$+\ 26^m\ 35^s, 50.$$

as the west longitude of Armagh from Greenwich.

The same chronometric comparisons appear to require that the value of the longitude of the Dublin Observatory,

as last determined by Dr. Brinkley, namely $+25^m\ 22^s,0$, should be diminished by about a second.

The Rev. Dr. Drummond read "An Essay on the Structure of English Verse, by the Rev. William Bruce, D. D."

This Essay enters into a critical examination of the constituent parts of English verse, commencing with its simplest elements, and following them up through their various combinations. As the melody of a language must depend on the classes of letters in which it most abounds, the poet should introduce as many vowels and liquids as possible; availing himself of those sounds which are most agreeable to the ear, and avoiding those which are guttural and harsh, unless when the latter may be more expressive in making the sound an echo to the sense. A propensity to imitative sounds appears through the whole of our language, and, in general, English has an advantage over the ancient languages, so far, at least, as expression depends on the termination of words.

The next element of verse is the *syllable;* and this must be considered as to quantity and quality. According to quantity, syllables are long or short; as to quality, smooth or rough. Accent affects particular syllables or letters, and the quantity or length depends on the manner of pronouncing the vowel, and on the number of consonants following it; for every consonant that is sounded must require some additional time. Whether the structure of English verse depends on quantity or accent, has long been a subject of controversy, and able critics are found on each side of the question. Sheridan affirms, that we have a peculiar advantage in having two sets of feet, the one depending on quantity, the other on accent. After all, it is little more than a dispute about words; accent alone will constitute verse, and there can be no verse without it; in fact its power is such, that we can hardly deny it to be the governing principle of

English versification. Our accent is different from that of the Greeks and Romans: ours lays more *stress* on vowels or syllables, theirs consisted in a depression or elevation of the voice; ours produces the effect of quantity, theirs was entirely distinct from such an effect.

Another stress of the voice, which has great influence on verse is, EMPHASIS, *i. e.* stress with expression. As accent is the ligament of a word, emphasis is the ligament of a sentence. It combines and points out the words which express a sentiment; and is produced by a change of tone adapted to the emotion which the sentiment inspires, not always elevated, but often (perhaps generally) low. The quantity of a syllable will often depend on emphasis; and hence it follows, that every composer of modulated prose or of verse, should be a good reader, or at least a good judge of reading, for if he read with one idea of accent and emphasis, and his lines are afterwards recited with a different one, it is plain that the metre will be spoiled.

An essential constituent part of verse is the FOOT. Our verse consists of feet, and not merely of a determinate number of syllables. The *iambus* is the foundation of English heroic verse, but other feet are admissible in particular places; and though the heroic line is said to consist of ten syllables, it often comprises many more. This foot was also the essence of the verse of the ancient tragedy and comedy, being best adapted to dialogue according to Horace,—*alternis aptum sermonibus*. It would seem, therefore, that the ancient drama is peculiarly fit for exact translation into English.

The excellence of verse consists, like that of beauty, in uniformity and variety. It supposes a regular order and recurrence of sounds; but if these be too uniform, it becomes tiresome,—if continually broken, the metre is confused.

The PAUSE is to be regarded as indispensable to the structure of verse, particularly the cæsural and the final

pause,—the former in the middle, the latter at the close of the line. The former does not always divide the line into two equal parts, but may be varied according to the taste of the writer; and in one line may be several pauses, though one is generally stronger than the rest.

In Latin, the cæsural pause is after the second foot; but in English, the taste of the poet is shown in changing its place. Expression often requires a deviation from rule, but care must be taken that the pause shall coincide with the sense, or even help,—certainly not mar it.

The difference between prose, verse, and poetry, is examined and explained at some length. They all consist of long and short, accented or unaccented syllables. Dionysius of Halicarnassus, and in our own day, Bishop W. Cleaver, could find a certain order of feet in Demosthenes and Isocrates. The rythm of prose is unfettered, that of verse confined within a certain number of feet. To this, poetry adds poetical diction and figures. Verse, in the opinion of the author, is essential to poetry. There may be verse without poetry, but no poetry without verse; and according to this decision, neither Fenelon's Telemachus, nor Macpherson's Ossian is to be considered as genuine poetry. In this, every thing should be animated and impassioned; not a single prosaic expression should be admitted into short poems; and if in long epic and didactic poems some indulgence to such expressions be allowed, it should be compensated by the greatest attention to melodious versification. With respect to the propriety of introducing the Alexandrine into heroic verse, there is a difference of opinion. Johnson condemns the practice, as violating the principle of verse; but Dryden, who understood the subject better, says, "Spencer gave me the boldness to use the Alexandrine. It adds a certain majesty to the verse, and stops the sense from overflowing into another line. I have frequently used the triplet rhymes, because they bound the sense, and therefore

I make the last verse of the triplet a Pindaric, (that is an Alexandrine,) for besides the majesty it gives, it confines the sense within the barrier of three lines, which would languish if lengthened into four."

After quoting the opinion of Dr. Johnson, of Dryden, and of a writer in Number XIV. of the Classical Journal, respecting blank verse, the author gives his own, and commences by stating it as necessary to the perfection of any art, that it should be difficult, χαλεπα τα καλα, and that the greater the difficulty, within certain bounds, the more excellent will be the execution. The facility of writing blank verse presents such a temptation to run out into long declamatory sentences, that it seldom gratifies the ear, except in some select passages, where the poet is inspired by the beauty of the subject. In rhyme the style is neater and more condensed; the figures and images are more approximated, and the impression more lively and vigorous. Variety in blank verse is often, perhaps generally, indulged even to extravagance, while uniformity is the reproach of rhyme.

The author maintains that the heroic hexameter of the ancients is incompatible with our language; and concludes with a variety of miscellaneous observations. An appendix is subjoined, containing notes and examples illustrative of facts and opinions occurring in the Essay.

The Secretary read the original Resolution of the Academy, by which the President of the Royal Society is an Honorary Member, and likewise, the resolution of Council of the 3rd of December, relating thereto.

It was ordered that the Diploma now read be engrossed on vellum, and transmitted to the Marquess of Northampton, President of the Royal Society.

The Academy then adjourned to the 14th January.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Par MM. les Secretaires Perpetuels. Second Semestre. No. 19, 20. Presented by the Academy.

Statement of the Receipts and Payments of the Royal Society, between Nov. 29th, 1837, *and Nov. 29th*, 1838. Presented by the Society.

Two Papyri, brought from Thebes in Upper Egypt, by George James Knox, Esq. Presented by Mr. Knox.

January 14, 1839.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Major Henry D. Jones; Charles E. H. Orpen, M. D.; Thomas Andrews, M. D.; P. M. Murphy, Esq.; Rev. James Wills; Richard Palmer Williams, Esq.; and Thomas Grubb, Esq., were elected Members.

His Grace, the Archbishop of Dublin, V. P., having taken the Chair *pro tempore*, the President communicated to the Academy the first part of his researches on the Dynamics of Light.

William Bald, Esq., Civil Engineer, read a paper entitled "An Account of the Survey and Map of the County of Mayo."

The author commenced by giving a brief account of the origin and progress of the construction of topographical maps in Europe. In modern times, the first attempt at the construction of topographical maps may be dated from the seventeenth century, and was due to the Swedes. Under Charles the Ninth, a surveying department was organized, placed

under the direction of Buræus, and particularly encouraged by Adolphus. In 1684, the Swedes had completed the general topographical map of Sweden; but it was kept secret, and at the end of a century, they had only published some parts of it. These maps were constructed for the purpose of ameliorating the condition of several provinces of the kingdom, which had been desolated by war. The Dutch also commenced early to construct topographical maps.

The measurement of many arcs of the meridian to determine the figure of the earth, had very much extended geodetical operations, and had, in many cases, become the elements on which topographical maps were based. The numerous geodetical surveys called into activity the inventive powers of the ablest artists in Europe, and instruments of extreme accuracy were produced; and the skill of observing and determining angles kept pace with those improvements connected with this important branch of science. The repeating principle due to the celebrated Tobias Meyer, gave birth to Borda's circle of repetition about 1789, an instrument which has been connected with the most brilliant scientific operations which adorn the annals of the eighteenth century.

Mr. Bald then showed to the Academy some specimens of the new map of France, and noticed briefly the trigonometrical survey of England—the Down survey of Ireland—the maritime surveys of Ireland—the county surveys, and the bog surveys. He made some observations on the great importance of accurate maps, especially to professional men engaged in conducting public works, such as roads, canals, river navigations, harbours, railways, supplying towns with water, irrigations; to the geologist and miner, exploring the strata, and mineral wealth of the country; to the statesman devising improvements, and developing its resources; and to the poor, by affording useful employment to the working classes.

The author then alluded to the map of Egypt, which was made during the period it was under the dominion of the French republic, and which received from Buonaparte all that protection and assistance, which so much distinguished him on all occasions regarding the advancement of the works of science. This map was engraved on fifty-three sheets of copper, and the names are engraved both in Arabic and French.

After this introductory account of the rise and present state of the topographical Art, Mr. Bald proceeded to the details connected with the survey of Mayo.

The instruments used in this survey, were a seven-inch theodolite; two five-inch theodolites, by Troughton; a small theodolite, by Dollond; and also a five-inch one by the same artist. In taking the levels over the bogs, two of Troughton's best levels were used. The barometers were made by Mr. Thomas Jones, of London. There were also two plain tables, a chain for measuring base lines, a sextant four inches radius, and two sextants, each ten inches radius, divided to ten seconds for observing altitudes, one of which was made by Troughton.

The proceedings of the geometrical details of the survey were then given, and the mode of describing the rise and fall of the ground, which was shaded on the map with a depth of colour corresponding to the sines of the angles of inclination. The irregularities of surface were simply delineated by hatching lines, drawn in the direction of the declivities, forming a series of normals, perpendicular to the horizontal lines of equal level.

Dr. Smith read a paper (by Lieutenant Newenham, R. N.), "on a Tumulus or Barrow, near Rush, County of Dublin."

The barrow, called Knocklea, or the Giant's Hill, is situated on the edge of the cliff, about midway between the

village of Rush, County of Dublin, and the martello tower to the northward, called Dromanick, and immediately in front of Sir William Palmer's residence, Kinure Park.

It appears to have been composed of quantities of boulder stones and earth heaped up into a conical form, and sloping away to the base, which was square, as appears from the eastern angle, which yet remains perfect. Within the base of the mound, there was a circle formed of large stones placed on their ends, and about one hundred paces in circumference.

The farmer who rents the land on which it stands has removed about one-half of the mound, for the sake of the earth as a manure, and nearly one-half of the circle of stones on the south side, for the purpose of building a wall, part of which is erected on the stones forming the western side of the circle. In the course of his depredations, he discovered a passage which opened on the south side;* its entrance was funnel-shaped, and the walls of this passage were formed of flag stones placed on their ends, and roofed in with the same. It was about eleven yards long, and one in width; and led to a low chamber about eight feet long, and six wide, which was situated nearly in the centre of the barrow, and formed of stones in the same manner as the passage.

The farmer removed all the stones forming the western side of the passage, and in the course of his excavations, found some human bones on the south side of the chamber, and within the circle of stones. The lines of stones forming the sides of the passage appear to continue on through the mound towards the north side; and a few feet below the present surface of the barrow, a little to the north of the chamber, there is a bed of periwinkle shells, about eight inches thick, with some limpet and muscle shells intermixed;

* Mr. Newenham thinks, that, as far as his observation has extended, the entrance of all barrows is on the south side.

and beneath this bed of shells there is a quantity of rich dark mould, with some reddish earth which has the appearance of being burned. A few human bones, and some bones of small animals, were found in the earth beneath.

Outside the circle of stones, and on the very edge of the cliff, near the western angle of the mound, there was found a rudely-formed grave, containing a human skull, with the bones of the arm, leg and thigh, which apparently had never been disturbed; the bones of the back, ribs, &c., could not be discovered.

There are several remains of entrenchments and smaller mounds in the neighbourhood.

Circles of stones are found enclosing many similar barrows in Ireland. At New Grange, near Dowth, in the County of Louth, the circumference of one measured about four hundred paces; and in a barrow near Drogheda, an engineer officer found a gigantic skeleton, a pair of elks' horns, and a spear, in an upright position: the horns were above the skeleton. There are many barrows in the neighbourhood of Drogheda, which, if opened under the direction of competent persons, would probably lead to many very interesting discoveries.

The President gave an account of a singular appearance of the clouds, observed on the 16th December, 1838, at the Observatory of Trinity College, Dunsink. They appeared, for at least the last four hours of day light, to be arranged in arches which converged very exactly to the N. E. and S. W. points of the horizon; while the breaks or joints in these arches were directed, though with less exactness, to two other horizontal points, which seemed to be always opposite to each other, but ranged from N. W. and S. E. to N. and S. Conjectures were offered with respect to the cause of this appearance.

The following alteration in Chapter VIII. Section 3, of the By-laws, was recommended by Council:—

"That in the Order of proceedings on the nights of meeting, the reading of the Minutes shall precede the Admission of new Members."

Adopted by the Academy.

The following alteration in Chapter IX. Section 3, of the By-laws, was recommended by Council, on the suggestion of the Committee of Publication:—

"That it is expedient to transfer to the Committees of Science, Polite Literature, and Antiquities, the duty of reporting, in future, on papers offered for publication in the Transactions."

Adopted by the Academy.

It was Resolved,—"That the Academy request, that any alteration in a By-law, proposed by the Council, shall be stated in full to the Members of the Academy, together with the existing By-law, so proposed to be amended."

The Academy then adjourned to Monday, the 28th of January.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. Par MM. les Secretaires Perpetuels. Tome Sixième; premier Semestre, Janvier — Juin, 1838; et second Semestre, Nos. 21 — 25. Presented by the Academy.

Annales Academiæ Gandavensis, &c. &c. 1817-1828. 11 Vols. Presented by the Academy.

Amputations dans la Contiguite des Membres. Par le Docteur Ch. Phillips, de Liège. Presented by the Author.

Notice sur la Vanille Indigène. Par Ch. Morren. Presented by the Author.

Morphologie des Ascidies. Par M. Ch. Morren. Presented by the same.

Quelques Remarques sur l'Anatomie de l'Ascaride Lombricoide. Par Ch. Morren. Presented by the same.

Proceedings of the Royal Society. No. 35, 1838. Presented by the Society.

Address of his Royal Highness the Duke of Sussex, K.G., &c., the President. Read at the Anniversary Meeting of the Royal Society, on Friday, November 30, 1838. Presented by the same.

Proceedings of the American Philosophical Society. Vol. I. No. 4. Presented by the Society.

Eulogy on Nathaniel Bowditch, LL.D., President of the American Academy of Arts and Sciences; including an Analysis of his Scientific Publications. By John Pickering, Corresponding Secretary of the Academy. Presented by the same.

An Eulogy on the Life and Character of Nathaniel Bowditch, LL.D., F.R.S. By Daniel Appleton White. Presented by the same.

A Discourse on the Life and Character of the Honourable Nathaniel Bowditch, LL.D., F.R.S. By Alexander Young. Presented by the same.

Religion of the ancient Irish Saints, before A. D. 600. By Henry J. Monck Mason, LL.D. Presented by the Author.

Historical Essay on the first Publication of Sir Isaac Newton's Principia. By Stephen Peter Rigaud, M.A., F.R.S., Hon. M.R.I.A., &c. Presented by the Author.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1839. No. 15.

January 28.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Mr. Ball read a paper on the Remains of Oxen found in the Bogs of Ireland.

Having alluded to the occurrence of fossil remains of oxen in Britain, and the existence of the Auroch or Wild Ox, in some parks in that country, he remarked on the old and generally received opinion, that Ireland could not furnish any evidence of having ever possessed an indigenous ox; and he stated, that a specimen which he received from the sub-marine forest, in the Bay of Youghal, seemed to have been the core of a horn of the fossil ox, often found in Britain, and supposed to have been the Urus; but this specimen having been lost, he alluded to it, to direct the attention of the Academy to the subject, in the hope of having his view confirmed. He then entered upon the principal object of his paper, which was to show, that the remains of oxen found at considerable depths in bogs in Westmeath, Tyrone, and Longford, belonged to a variety or race, differing very remarkably from any noticed in Cuvier's "Ossemens Fossiles," or any other work with which he was acquainted. He concluded by expressing a conviction, that Ireland had possessed at least one native race of oxen, distinguished by the convexity of the upper part of the forehead, by its great proportionate length, and by the shortness and downward direction of the horns. As this fact seems to have escaped altogether the notice of

British and continental naturalists, and as analogy in the case of other Irish mammals justified the view, he urged the great probability of the race in question proving to be one peculiar to Ireland.

Mr. Ball exhibited specimens and drawings, and solicited the co-operation of Members of the Academy, in effecting a perfect elucidation of the subject, by collecting specimens from the bogs of the country.

Dr. Kane read an account of a substance which has hitherto been confounded with white precipitate. It is formed by precipitating in the cold, a solution of sal-alembroth by carbonate of potash, or by boiling true white precipitate in a strong solution of sal-ammoniac. The composition of this body is expressed by the formula $HgCl + NH_3$, and Dr. Kane considers it as intermediate between true white precipitate and sal-ammoniac.

This substance was noticed independently by Professor Woehler, as being found in commerce under the name of white precipitate. He, however, recommended it to the attention of chemists without analyzing it.

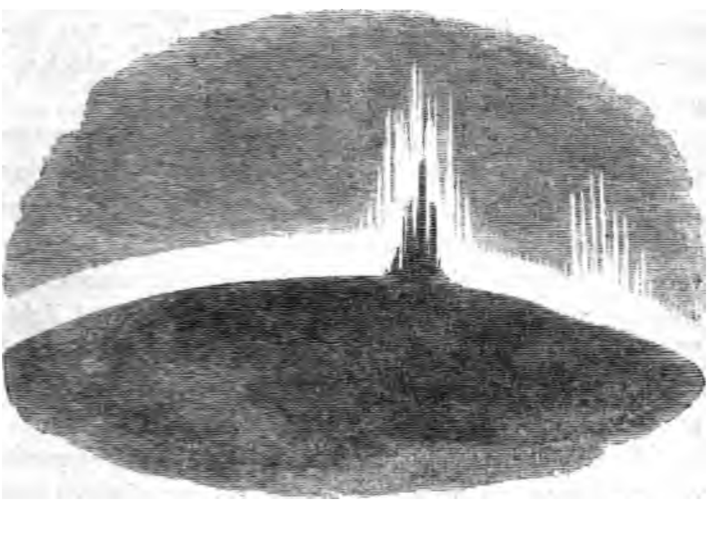
Rev. H. Lloyd, V. P., read a "Note of Observations made during the remarkable Aurora of the 19th inst."

Mr. Lloyd commenced by stating, that the approach of this beautiful phenomenon was indicated in Dublin, at an early hour, by the disturbance of the magnets in the Observatory. At five o'clock, both magnetometers testified the setting in of what Humboldt calls a "magnetical hurricane;" the disturbance in *declination* amounting, in the course of a quarter of an hour, to 20.7 minutes, while the corresponding change in the *intensity* of the horizontal component of the magnetic force, was 0092, or nearly the one-hundredth part of the whole.

Shortly before 10 o'clock, a broad and brilliant arch was

formed, the lower limb of which was beautifully defined. The remarkable feature in this phenomenon was the *intense blackness* of the sky beneath the arch, as contrasted with that exterior to it. The darkness of this space was such, as to resemble a dense cloud, fringed by the auroral light; and the doubt was suggested, whether the *dark cloud* noticed by many observers, in connexion with aurora, may not have been an appearance of the same kind, though less regular in its outline. In the aurora of the 19th, the blackness of the space enclosed by the arch was certainly not due to the presence of a cloud, for the stars were distinctly visible in it. Mr. Lloyd stated, that he was so much interested in this part of the phenomenon, as to lose the opportunity of obtaining a measure of the altitude of the arch.

Soon after 10 o'clock, the arch began to break up into streamers. Its appearance at this period was such as is represented in the subjoined sketch.



From this time, until half past eleven o'clock, Mr. Lloyd took no notes of the appearances, having been engaged in

watching the motions of the magnetometers in the Observatory.

At half-past eleven o'clock, the streamers were very splendid, and covered the whole sky, appearing to spring, however, chiefly from the N. E. They were remarkable for the intensity of their light; the irregularity of their forms (seldom affecting the usual rectilinear form;) and their incessant dancing motion. At first, the flashes of light appeared in broad irregular masses, at considerable intervals over the sky, like scattered clouds illuminated by the moon, except that their appearance was momentary; or (as they have been described) like the jets of illuminated vapour, shot from the boiler of a locomotive engine. About twelve o'clock, they spread themselves over the face of the sky, and exhibited a nearer approach to their usual form. At this period, a distinct point of convergence, a little to the S. E. of the zenith, was occasionally exhibited; and a marked contortion of the auroral clouds, at this point, showed the tendency to the formation of the *corona*. There was likewise a stationary luminous cloud, to the S. E., which appeared to be connected with the phenomenon.

After twelve o'clock, the brilliancy of the phenomenon in the upper part of the sky gradually lessened; but a very intense auroral light, with streamers, still remained in the N. W. The atmosphere was remarkably clear, and the stars very bright; the cloud-like patches of the aurora not seeming to present any obstacle to the transmitted light. There was a cold cutting wind, which came in gusts; and it seemed as if these gusts were simultaneous with the flashes of the aurora.

Mr. Lloyd then presented a table, exhibiting the results of observation with the two magnetometers, one of which measures the changes of *declination*, and the other those of the *horizontal* part of the earth's *magnetic force*. The observations commenced at $10^h\ 25^m$, and were continued, at intervals

of three minutes, for one hour. The table contained the direct results of observation with the two instruments; the differences of these results and the means of the day, (or the *disturbances* in declination and horizontal force,) estimated in parts of the scale; and the same differences reduced to their proper measures. The extreme disturbance in declination, amounted to 17′.9; and that of the horizontal force to .0127. The changes of the horizontal component of the force arising partly from changes of the *total force*, and partly from changes of *inclination*, and the part due to the latter being, in high magnetic latitudes, much the greater, it is manifest that the changes of inclination may be deduced, approximately, from those of the horizontal force, on the assumption that the actual force remains unvaried. The changes of inclination, thus deduced, were given in another column of the table.

The numerical values of the changes of declination and inclination thus obtained, were laid down in charts, so as to represent graphically the progress of the disturbance of each of the elements of the magnetic direction. In a third chart the combined effect of the two disturbances was represented, so as to exhibit the successive positions of the pole of the needle, supposed free to move in every direction. From this it appeared, that in the present instance, the effect of the auroral disturbance upon the resultant direction of the earth's magnetic force, has been to impress upon the pole of the needle a kind of epicycloidal movement. It will remain for future observations to determine whether or not this is a general law; the light that such an inquiry must throw on the nature of the disturbance need not be insisted on.

The aurora appears to have been frequent about this period. Two days after this observation, on the 21st, at nine o'clock in the evening, the magnetometers were again disturbed. The extreme positions observed, occurred at $9^h\ 10^m$, and $9^h\ 35^m$; and in this interval the change of decli-

nation amounted to 53′.8, while the change of the horizontal force was .004. At the time of this observation, the sky was overcast with light fleecy clouds; but in the course of the evening the aurora was seen.

The following additional notes were furnished by Mr. Bergin.

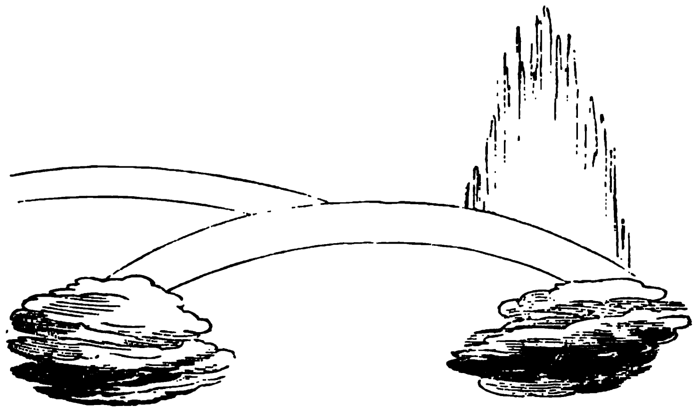
"The aurora was first seen about half past five o'clock P. M. as a luminous arched bank, on the N. W. horizon, extending about 30° horizontally, and having a versed sine of about 15° vertical, with occasional very thin, luminous, cloud-like patches, stretching to the zenith. It was some minutes before I could be certain, whether it was aurora or only vapoury clouds. About half an hour afterwards, there was a very well defined luminous arch over the bank, and parallel to it, perhaps 10° higher, with motionless streamers from the bank towards the arch. From the summit of the latter there sprung a vertical arch, (very faint,) which extended nearly to the zenith, where there was a faint circular patch (corona?)

"The space between the bank and the horizontal arch was intensely dark; yet that the darkness was not caused by clouds, was evident, as a few stars were distinctly visible within this space. At this time there was a very remarkable brush of light, commencing apparently at the centre star of Orion's belt, diverging southward for 10° or 12°, and slightly inclined upwards: this brush was perfectly motionless, and remained altogether unchanged during an interval of five minutes or thereabouts; my attention was then for a short time directed to the arch, and when I again looked towards Orion, the brush had entirely disappeared.

"About nine o'clock, the horizontal and vertical arches, as well as the coronal patch, had quite disappeared; or rather they had united with the bank first described.

"At half past ten the appearance had again changed,

and presented part of an arch based upon the upper part of another,—this latter throwing out singularly brilliant coruscating streamers towards the zenith, while it rested on luminous clouds, near the horizon, somewhat in this manner:



About twelve o'clock I could only see a luminous cloud, not very extensive, towards the N. W., with the ordinary flashing and playing masses of light.

"The colour of the aurora, when first seen, was slightly reddish, afterwards decidedly yellow; the streamers were occasionally very brilliant and perfectly white."

The subject of the aurora having been brought before the Academy, Dr. Apjohn took the opportunity of describing a very beautiful phenomenon of the kind, which had been observed on the 16th of last September, at Sunville, in the county of Limerick. It was first noticed at about half past eight o'clock in the evening, and did not disappear for very nearly an hour. It was first seen in the southern part of the hemisphere, and consisted of a number of streamers of variable brilliancy, shooting upwards in vertical circles, or, more strictly speaking, converging towards a point which appeared a few degrees to the south-east of the zenith. They did not in any case originate from the hori-

zon, but from points having an altitude of about 40°; and they very frequently extended upwards to their point of intersection, producing there a light of considerable intensity. The illuminated sector of the sky, supposing it prolonged to the horizon, subtended an angle of about 30°. The most remarkable circumstance connected with this aurora was the following. About nine o'clock, it began to move slowly round, taking an easterly direction; and when, in the course of fifteen or twenty minutes, it attained a north-westerly bearing, the sky was lighted up on every side with singular brilliancy. The appearance which now presented itself, is best conveyed by stating, that it was precisely such as would be produced by the extension, *at the same instant,* of the aurora already described, through every point of azimuth. This magnificent illumination lasted only about a minute, but left behind it, very nearly due west, a fasciculus of beams quite similar to those which first attracted attention.

The night was remarkably fine and still, having been preceded by a day of unusual warmth and sunshine. The sky was not destitute of clouds, but they had a considerable elevation, were small and scattered, and were penetrated by the light of the stars, which were visible in considerable numbers.

Mr. George Downes read extracts of a second letter from Professor Rafn, Secretary to the Royal Society of Northern Antiquaries of Copenhagen. In this letter Professor Rafn suggested that, as his researches relative to America appeared to be, as yet, but little known in Ireland, it might perhaps be advisable, that his "Memoir on the Discovery of America in the tenth Century," already published at Copenhagen in the *Antiquitates Americanæ,* should be reprinted in the Transactions of the Academy, with an introduction, which he proposed to furnish, and with some ad-

ditional remarks on "Great Ireland." Professor Rafn took occasion also to solicit contributions of books or money, for a public library which had been established by himself, in 1818, at Reikiavik, the capital of Iceland, "whose inhabitants," he says, "have but little opportunity of gratifying their thirst for information." The library now numbers 7500 volumes, and possesses a permanent fund of 1500 rixdollars, for which it is partly indebted to "some noble-minded Englishmen." With reference to the subject of this letter, Mr. Downes remarked, that the island for which Professor Rafn felt so much interest, had peculiar claims on the sympathy of Irishmen, as having been, like their own island, a place of refuge for literature, when banished from the continent of Europe. He then renewed his application to the Academy for a contribution to the funds of the Royal Society of Northern Antiquaries, observing, that they had shown great readiness to lend their aid in the elucidation of Irish antiquities, which indeed were intimately connected with their own; and that a work, which they now had in contemplation, was specially devoted to the antiquities of Great Britain and Ireland; a work, however, of such magnitude, that it might never see the light, unless a liberal supply could be raised for the funds of the Society.

It was RESOLVED, that Mr. Downes be requested to communicate with the Council on this subject.

RESOLVED,—on the recommendation of Council, that in the By-law, Chap. VIII. Sec. 5. the words "altered or repealed" be inserted after the word "confirmed."

The Secretary of Council stated, that the Council, in consequence of the expressed wish of the Academy, had resolved, "that any alterations in By-laws, proposed by the Council, shall be stated *in full* to the Members of the Academy, together with the existing By-law, so proposed to be amended; and that this notice shall be given *in print*."

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Par. MM. les Sécretaires Perpetuels. Second Semestre, Nos. 26 and 27. Presented by the Academy.

Memorie della Reale Accademia delle Scienze di Torino. Tome XL. Presented by the Academy.

Transactions of the Society of Civil Engineers. Vol. II. Presented by the Society.

Report of a Committee of the Royal Society, on the Propriety of recommending to her Majesty's Government, the Establishment of fixed Magnetic Observatories, and the Equipment of a Naval Expedition for Magnetic Observations in the Antarctic Seas; together with the Resolutions adopted on that Report by the Council of the Royal Society. Presented by the Society.

Rough Sketches, intended to aid in developing the Natural History of the Seals, (Phocidæ) of the British Islands. By R. Ball, Esq. Presented by the Author.

The Expediency and Facility of establishing Metrological and Monetary Systems throughout India, on a scientific and permanent Basis, grounded on an analytical Review of the Weights, Measures, and Coins of India, &c. &c. By Captain T. B. Jervis. Presented by the Author.

The Indian Review, and Journal of Foreign Science and the Arts. Edited by Frederick Corbyn, Esq. Vol. II. Presented by the Editor.

February 11.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The Rev. Robert Vickers Dixon, F.T.C., was elected a Member of the Academy.

Mr. George Smith presented to the Academy an original portrait of General Vallancey, by Chinnery.

The thanks of the Academy were voted to Mr. Smith for his valuable donation.

Mr. William Bald, civil engineer, read a paper, containan account of his models of the Island of Achil, Clare Island, and the south western district of Mayo, which comprises the greater part of the barony of Murrisk, and a portion of the barony of Burrishoole.

After an introduction, in which the author calls attention to modelling, as the best mode of representing the rise and fall of ground, and makes some remarks on the undeserved neglect which the subject has hitherto met with in this country, he proceeds to state, that his model of Clare Island was made on a scale of eight inches to the Irish mile; and that the models of Achil Island, and Murrisk Barony, were on scales of four inches to the English mile. The vertical scales were the same as the horizontal. The model of the barony of Murrisk is at present deposited in the house of the Royal Dublin Society. The original model of Clare Island is in the possession of the Royal Society of Edinburgh; and the model of Achil has been deposited in the Museum of the College of Edinburgh. The model of Murrisk represents the area of a country containing nearly two hundred square miles; that of Achil represents a country containing about fifty-eight square miles; and Clare Island is about four English miles long, by two and a quarter in its greatest breadth. These models were constructed with a composition of putty, white lead, and cork. The paper gives an account in detail of the mode of their construction.

In ascertaining the levels of the country, Mr. Bald recommends that lines of equal level be adopted, and also

transverse sections made. He states that neither Ben Nevis in Scotland, Snowdon in Wales, nor Macgillycuddie's Reeks in Ireland, have had their heights ascertained by actual levelling; and he observes, that were these heights accurately determined, further knowledge might then be obtained regarding refraction, and the measurement of altitudes by the barometer. A small map of the island of Inish Turk, on which are delineated lines of equal level, accompanies the paper.

In conclusion, Mr. Bald observes, that a model of a country in the hands of the topographic, military, civil, or mining engineer, could be applied to a variety of useful purposes; and particularly that it would enable young men to shade accurately topographic maps, a thing that has not yet, to his knowledge, been systematically attended to in any of the institutions of Great Britain or Ireland.

Rev. H. Lloyd, V. P., read a paper "on the relative Position of three Magnets, in a Magnetical Observatory."

It is a problem of much importance, in connexion with the arrangement of a magnetical observatory, to determine the relative position of the magnetical instruments in such a manner, that their mutual action may be either absolutely null, or at least, readily calculable. Such was stated by the author to be the object of the investigation now laid before the Academy.

In the case of *two* horizontal magnets, one of which (intended for observations of *declination*) is in the magnetic meridian, and the other (used for observations of *horizontal intensity*) is in the perpendicular plane, there is nothing to compensate the action of each magnet on the other. The best thing that can be done in this case, is to determine the position of the second magnet in such a manner, that the direction of its action on the first shall coincide with *the magnetic meridian.* In such case, the position of the first

magnet will be undisturbed by the second, so as to give the *absolute declination* truly; and, as to the *variations* of the declination, it is manifest that they will be thereby increased or diminished in a *given ratio;* so that the true variations will be obtained by simply altering the coefficient of the scale. When the above-mentioned condition is introduced into the equation which determines the direction of the resultant force exerted by one magnet on another, (the length of the magnets being supposed small in comparison with the distance between them,) we find, for the azimuth of the line connecting the two magnets, referred to the magnetic meridian,

$$\text{arc}\left(\tan = \frac{1}{\sqrt{2}}\right) = 35^\circ\ 16'.$$

This result has been already obtained by Gauss and Weber.

It is manifest that, in this case, the action of the first magnet on the second will not take place, either in the magnetic meridian, or in the plane perpendicular to it; so that the second magnet is necessarily disturbed. With two magnets, accordingly, it is impossible to avoid the effects of mutual action. The case is different, however, when a *third* magnet is introduced. It is then possible to annul completely all action, with the exception of that exerted on the third magnet by the first and second; and this, in the case under consideration, is destroyed by the nature of the suspension.

The third magnet about to be employed in the Dublin Observatory is intended for the observation of the *vertical component of the magnetic force*. It is a bar supported on knife-edges, capable of motion in a vertical plane, and brought into the horizontal position by means of a weight. The three instruments being in the same horizontal plane, it is manifest that the action of the first and second on the third must take place in that plane; and this action can have no effect in disturbing the magnet, its motion being

confined to the vertical plane. It is only necessary to consider, therefore, the action on the first and second magnets.

The author then proceeded to the conditions of equilibrium of these actions, which were expressed by four equations, containing four arbitrary angles; so that this equilibrium is, in general, attainable, by suitably determining the position of the three magnets, whatever be their relative intensities.

In practice, however, it will seldom happen, that we can regard as arbitrary all the four angles which enter these equations, one or more of them being, in general, determined by some circumstance connected with the locality. In such case the complete destruction of all action is no longer possible; and we must look for some other solution of the problem of mutual interference.

Next to the complete destruction of all action, the most desirable course is to give to the resultant action such a direction, that its effect may be readily computed and allowed for. In the case of the declination bar, it is easily seen that this direction is the magnetic meridian itself; the *mean* position of the bar being thereby *unaltered*, and the *variations* of its position only increased or diminished in a given ratio. By means of a simple investigation it is shown, that the same thing is true of the horizontal intensity bar; and that, in order that the variations of *declination* may not be mixed up with those of *force*, the resultant force exerted upon this magnet by the other two must lie in the magnetic meridian. The problem, therefore, is reduced to this:—to determine the position of the three magnets A, B, and C, in such a manner, that the resultant actions exerted upon A and B, respectively, by the other two, shall lie in the magnetic meridian.

The solution of this problem was shown by the author to be contained in the two following equations:

$$\sin^3(\alpha+\beta)\,[3\sin(u+\nu-2\alpha)+\sin(u-\nu)] \\ +2q\sin^3\beta\,(3\sin^2u-1)=0.$$

$$\sin^3(\alpha+\beta)\,[3\sin(u+\nu+2\beta)+\sin(u-\nu)] \\ +6p\sin^3\alpha.\ \sin u\cos u=0.$$

in which α and β denote the angles BAC and ABC, of the triangle formed by the lines joining the three magnets; u and v, the angles which the directions of the magnets, A and C, make with the line AB; and p and q the ratios of the forces of the magnets A and B to that of the third magnet C, at the unit of distance.

The paper concluded with the application of the formulæ to some remarkable cases,—as, when the three magnets are in the same right line; when the line joining two of them is in the magnetic meridian, or perpendicular to it; &c.

The Chair having been taken, *pro tempore*, by his Grace the Archbishop of Dublin, V. P., the President continued his account of his researches in the theory of light.

As a specimen of the problems which he had lately considered and resolved, the following question was stated:— An indefinite series of equal and equally distant particles, $\ldots\ m_{-1},\ m_0,\ m_1,\ldots$, situated in the axis of x, at the points $\ldots\ -1,\ 0,\ +1,\ \ldots$, being supposed to receive, at the time 0, any very small transversal displacements $\ldots\ y_{-1,0},\ y_{0,0},\ y_{1,0},\ \ldots$, and any very small transversal velocities $\ldots\ y'_{-1,0},\ y'_{0,0},\ y'_{1,0},\ \ldots$, it is required to determine their displacements $\ldots\ y_{-1,t},\ y_{0,t},\ y_{1,t},\ \ldots$ for any other time t; each particle being supposed to attract the one which immediately precedes or follows it in the series, with an energy $=a^2$, and to have no sensible influence on any of the more distant particles. This problem may be considered as equivalent to that of integrating generally the equation in mixed differences,

$$y''_{x,t} = a^2 (y_{x+1,t} - 2y_{x,t} + y_{x-1,t}); \qquad (1)$$

which may also be thus written:

$$\left(\frac{d}{dt}\right)^2 y_{x,t} = \frac{(a\Delta_x)^2}{1+\Delta_x} y_{x,t}. \qquad (1)'$$

The general integral required, may be thus written:

$$y_{x,t} = \left\{1 - \frac{a^2\Delta_x^2}{1+\Delta_x} (\textstyle\int_0^t dt)^2\right\}^{-1} (y_{x,0} + t\, y'_{x,0}); \qquad (2)$$

an expression which may be developed into the sum of two series, as follows,

$$y_{x,t} = y_{x,0} + \frac{a^2t^2}{1.2} \Delta_x^2 y_{x-1,0} + \frac{a^4t^4}{1.2.3.4} \Delta_x^4 y_{x-2,0} + \&c.$$

$$+ t y'_{x,0} + \frac{a^2t^3}{1.2.3} \Delta_x^2 y'_{x-1,0} + \frac{a^4t^5}{1.2.3.4.5} \Delta_x^4 y'_{x-2,0} + \&c.; \qquad (2)'$$

and may be put under this other form,

$$y_{x,t} = \frac{2}{\pi} \Sigma_{(l)-\infty}^{\infty} y_{x+l,0} \int_0^{\frac{\pi}{2}} d\theta \cos(2l\theta) \cos(2\,at \sin\theta)$$

$$+ \frac{1}{a\pi} \Sigma_{(l)-\infty}^{\infty} y'_{x+l,0} \int_0^{\frac{\pi}{2}} d\theta \cos(2l\theta) \operatorname{cosec}\theta \sin(2\,at\sin\theta); \qquad (2)''$$

the first line of (2)′ or (2)″ expressing the effect of the initial displacements, and the second line expressing the effect of the initial velocities, for all possible suppositions respecting these initial data, or for all possible forms of the two arbitrary functions $y_{x,0}$ and $y'_{x,0}$.

Supposing now that these arbitrary forms or initial conditions are such, that

$$y_{x,0} = \eta \operatorname{vers} 2x\frac{\pi}{n}, \text{ and } y'_{x,0} = -2a\eta \sin\frac{\pi}{n} \sin 2x\frac{\pi}{n}, \qquad (3)$$

for all values of the integer x between the limits 0 and $-in$, n and i being positive and large, but finite integer numbers,

and that for all other values of x the functions $y_{x,0}$ and $y'_{x,0}$ vanish: which is equivalent to supposing that at the origin of t, and for a large number i of wave-lengths (each $= n$) behind the origin of x, the displacements and velocities of the particles are such as to agree with the following law of undulatory vibration,

$$y_{x,t} = \eta \text{ vers} \left(2x \frac{\pi}{n} - 2at \sin \frac{\pi}{n}\right), \tag{3'}$$

but that all the other particles are, at that moment, at rest: it is required to determine the motion which will ensue, as a consequence of these initial conditions. The solution is expressed by the following formula, which is a rigorous deduction from the equation in mixed differences (1):

$$y_{x,t} = \frac{\eta}{\pi}\left(\sin\frac{\pi}{n}\right)^2 \int_0^\pi \frac{\sin in\theta}{\sin\theta} \, \frac{\cos(2x\theta + in\theta - 2at\sin\theta)}{\cos\theta - \cos\frac{\pi}{n}} \, d\theta; \tag{4}$$

an expression which tends indefinitely to become

$$y_{x,}{}^{t} = \frac{\eta}{2} \text{ vers} \left(2x\frac{\pi}{n} - 2at\sin\frac{\pi}{n}\right)$$

$$- \frac{\eta}{2\pi}\left(\sin\frac{\pi}{n}\right)^2 \int_0^\pi \frac{\sin(2x\theta - 2at\sin\theta)}{\sin\theta\left(\cos\theta - \cos\frac{\pi}{n}\right)} \, d\theta, \tag{4'}$$

as the number i increases without limit. The approximate values are discussed, which these rigorous integrals acquire, when the value of t is large. It is found that a vibration, of which the phase and the amplitude agree with the law (3)′, is propagated forward, but not backward, so as to agitate successively new and more distant particles, (and to leave successively others at rest, if i be finite,) with a velocity of progress which is expressed by $a \cos \frac{\pi}{n}$, and which is therefore less, by a finite though small amount, than the velocity of passage $a \frac{n}{\pi} \sin \frac{\pi}{n}$ of any given phase, from one vibrating

particle to another within that extent of the series which is already fully agitated. In other words, the communicated vibration does not attain a sensible amplitude, until a finite interval of time has elapsed from the moment when one should expect it to begin, judging only by the law of the propagation of phase through an indefinite series of particles, which are all in vibration already. A small disturbance, distinct from the vibration (3)′, is also propagated, backward as well as forward, with a velocity $= a$, independent of the length of the wave. And all these propagations are accompanied with a small degree of terminal diffusion, which, after a very long time, renders all the displacements insensible, if the number i, however large, be finite, that is, if the vibration be originally limited to any finite number of particles.

Dr. Apjohn read a paper by George James Knox, Esq. "on the Direction and Mode of Propagation of the electric Force traversing Media which do not undergo Electrolyzation."

In the commencement of this paper, the author details experiments, which appear to him to justify the inference, that when an electric circuit is completed through water or melted phosphorus, the current passes directly through the substance of these media, but that when, for these, a metal such as lead is substituted, the electricity moves exclusively along its surface. He next considers the source and mode of propagation of the electric force, developed in the pile, and after a brief review of the theories and experiments of Davy, Faraday, and Becquerel, arrives at the following conclusion, viz. that an electric current originates in a natural electro-inductive power of bodies when brought into contact, which affects the circumambient ether of each particle, and is continued by alternate states of induction and equilibrium; the amplitude of the oscillations of the electrical ether con-

stituting the quantity, as their rapidity constitutes the intensity, of the electrical current.

Dr. Aquilla Smith exhibited to the Academy, an ancient Irish bell, of a square form, found near Fintona in the county of Tyrone.

It was resolved, (on the recommendation of Council,) "that any Member of the Academy, who proposes the name of a candidate, shall give, *in writing*, the grounds on which he recommends such candidate for admission; and that such statement shall be read by the President from the chair previous to the ballot."

It was resolved, (on the recommendation of Council,) "that the following shall, in future, be the mode of balloting in the election of Members:—

"Members balloting are to mark with *an asterisk* the name of the candidate or candidates whom they desire to *admit*; to draw a *line through* the name of the candidate or candidates whom they wish to *reject*; and to leave the name unmarked when they do not vote at all."

DONATIONS.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Par MM. les Secretaires Perpetuels. No. I. Premier Semestre, 1839. Presented by the Academy.

An original Portrait of General Vallancey, by Chinnery. Presented by George Smith, Esq.

February 25.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Rev. H. Lloyd read a letter which he had recently received from M. D'Abbadie, relating to his scientific expedition in Africa. The following is an extract.

"ADWA, (ABYSSINIA,) *July 24th*, 1838.

"Our voyage to Abyssinia (my brother accompanied me) was chiefly undertaken in order to learn the principal languages of that country, and the best manner of travelling in it, with a view of returning to Europe, there to prepare a complete and well directed expedition. We left Cairo in December 1837, and proceeded by Keneh and Ckosair to Djiddah, where I took a great deal of pains to correct, by local information, the nomenclature of places on the Red Sea. We next proceeded to Massawwa, where I remained alone for nearly two months, studying the Habābi tongue, a Semitic language, nearly allied to Ethiopic, and spoken from Ansky Bay almost as far as Sawakim. The customs and manners of the Habāb tribes afforded me several proofs of their Arabian origin. On my brother's return from the high lands of Abyssinia, I proceeded with him into that country, carrying our baggage, instruments, &c. Unfortunately we were detained so long on the road, by a chain of untoward circumstances, that the rainy season set in before we reached this place. After a forced stay of twenty days, and a tiresome journey of twenty more, we arrived safely in Goander, the splendid but fallen capital of Ethiopia. Here I made myself master of the Amarña language, at least enough to travel without an interpreter, and got some valuable information on the sources of the White Nile. Our object being now attained, it was high time to turn back before the swollen waters of the Tacazay had com-

pletely shut up the road towards the sea-coast. But my brother could never be induced to give up the game that seemed already within his grasp; and when we parted at Goander, he was already directing his steps to the unknown regions of Damoh, Enārea, Kāfa, and Djandjow. May the Almighty God look with favour on the daring and lonely traveller!

"I need not tell you that all my barometers were shivered to atoms long before I crossed the mountain passes of Abyssinia. I was obliged to have recourse to observations on the temperature of boiling water, for which I was provided with an excellent and delicate thermometer. As authors do not exactly agree in the manner of calculating these observations, I shall here insert some of the original entries. They will throw some light on the long disputed question of the height of Abyssinian mountains.

			Boiling Water.	Air.
"Mountains near Halay (primitive rocks)	29th March,	6 A. M.	93°.9	14°.4
Adwa *id.*	10th May,	8 A. M.	94.15	25.3
Terasöga (east bank of the Tacazay)	19th May,	8½ A. M.	95.18	25.8
Tacazay, (close to the water) . .	20th May,	9 A. M.	97.30	25.0
Amödjāgi, (west bank of the Tacazay)	27th May,	6 A. M.	90.80	20.0
Goander, ...	8th June,	7 P. M.	93.25	22.2
Kāba, (village near Samen) . .	5th July,	5 A. M.	91.35	18.3
Ewāri, (on Mount Bawhit) trap rocks	7th July,	Noon,	89.56	24.1

"The summit of Mount Bawhit is at least 1800 feet above the village of Ewāri. This Mount Bawhit is, after Amba Hai, the highest mountain in Abyssinia. When I crossed part of it, the ground was covered with unmelted hail, which looked at a distance like snow. This observation conciliates in some measure the conflicting testimonies of Bruce and Salt."

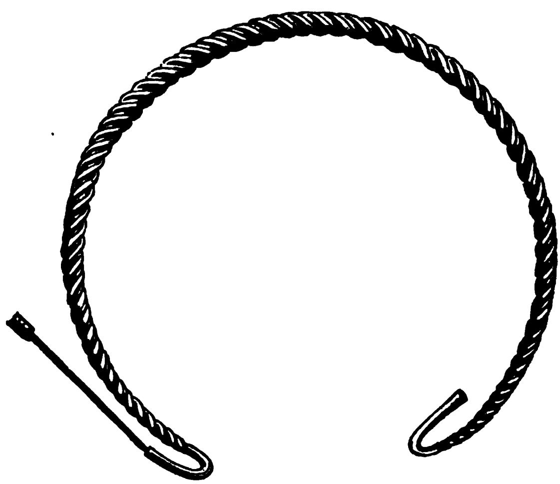
"ALEXANDRIA, 31st *December*, 1838.

"I had deferred closing this, until I could discover some means of forwarding it to Europe. Unfortunately, after a long and fruitless delay, I was compelled to be my own mes-

senger as far as Egypt. On my way home, I sailed from Massawwa to Mokha, where I collected several valuable remarks on the language and country of the Somāli. During three tedious months on the Red Sea, I succeeded in learnthe Ilmorma language, which is spoken through immense tracts of central Africa. I am now hastening to Europe, where I shall lay an abstract of my journey before the scientific world."

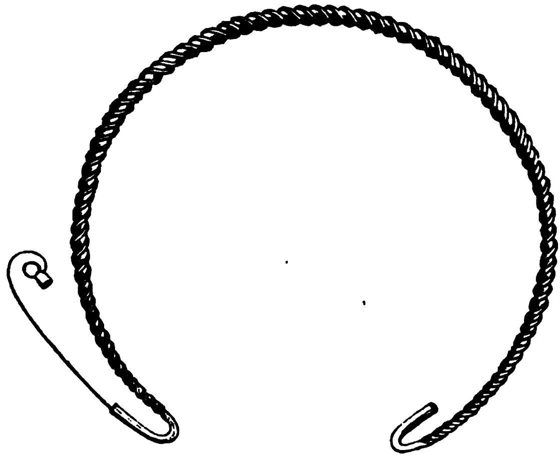
Mr. Lloyd made a few remarks on the heights of the mountains, as determined by the preceding observations.

Mr. Petrie exhibited to the Academy two golden Torques or collars, found about twenty-five years ago on the Hill of Tara, the residence of the Irish monarchs anterior to the sixth century. The first is five feet seven inches in length, and weighs 27 oz. 9 dwts. The second is five feet six inches in length, but weighs only 12oz. 6dwts. These Torques are of a screw or spiral pattern, as will be seen from the subjoined wood cuts; and though the design is rude, the



workmanship is of great beauty. Torques of similar size and pattern have been frequently found in Ireland, and

are often accompanied by armillæ or bracelets of the same description.



The term *Torques*, by which antiquarians usually designate these ornaments, is one of frequent occurrence in the classic authors. The word is generally derived from the Celtic *Torc*, a twisted collar, or perhaps, more correctly, a twisted circular ornament of any kind, as the ancient Irish called a collar or neck-chain *mun-torc*. And since the Latin verb *torqueo* has no cognate in Greek, it is probably formed from the same Celtic root.

Collars of this kind seem to have been common to all the Celtic nations, as we find from ancient writers. Livy tells us, that Publius Cornelius, in his triumph over the Boii, a Gallic nation, collected, among the spoils, no less than 1470 Torques: and we find in Propertius, that Virdumarus king of the Gauls, wore such an ornament. Dio Cassius notices a Torc of this description, as ornamenting the person of the British Queen Boadicea; and even within a few centuries of the present time, a Welsh Prince was called Llewellin *aur dorchag*, or Llewellin of the Golden Torc. The Torques found in France and Wales are exactly similar to the

Irish: a fine one found near Harlech, in the year 1692, is preserved in the Mostyn family in Flintshire.

It has been supposed by some antiquarians, that the use of these ornaments was derived from the Romans. But the great number discovered in Ireland is opposed to such a conjecture, and we may with much greater probability refer them to a Celtic origin. It does not appear that they were generally worn by the Romans; and the very appellation *Torquatus*, which was bestowed on Titus Manlius, from the Golden Torc taken by him from a Gaul, whom he slew in the year of Rome 393, and which was continued as a surname in his family, seems to indicate, that the *Torques* was not familiar to the Romans at the time.

The Rev. H. Lloyd, V. P., laid on the table the *stereoscope* of Professor Wheatstone, and briefly explained the information which it afforded on the laws of binocular vision.

The President delivered the following Address to the Academy.

I have now the honour to inform you, that your Council, in the exercise of the discretion entrusted to them by you, have taken into their consideration, since the commencement of the present session, the various papers which had been for a few years past communicated to our Transactions, on several different subjects, in order to determine whether any and which of those papers should be distinguished by the award of a Cunningham Medal: and that the medal for the most important Paper in Physics, communicated to us during the three years ending in March, 1838, has been adjudged to Dr. Apjohn, for his Essay on a New Method of investigating the Specific Heats of the Gases, published in the First Part of the Eighteenth Volume of the Transactions of this Academy.

The importance of the study of what are called the imponderable agents, is known to all physical inquirers. Indeed it would appear, that as the scientific history of Newton, and of his successors during

the century which followed the publication of his Principles of Natural Philosophy, is connected mainly with the establishment of the law of universal gravitation, and with the deduction of its chief consequences; so are the mathematical and physical researches of the present age likely to be associated, for the most part, with the study of light and heat and electricity, and of their causes, effects, and connexions. Whatever, then, whether on the practical or on the theoretical side, in the inductive or the deductive way, may serve to extend or to improve the knowledge of these powerful and subtle agents or states of body, which are always and everywhere present, but always and everywhere varying, and which seem to be concerned in all the phenomena of the whole material world, must be received by scientific men as a welcome and valuable acquisition.

Among researches upon heat, the highest rank is, (I suppose,) by common assent, assigned to such works as those of Fourier and Poisson, which bring this part of physics within the domain of mathematical analysis. That such reduction, and to such extent, is possible, is itself a high fact in the intellectual history of man; and from the contemplation of this fact, combined with that of the analogous success which it was allowed to Newton to attain in the study of universal gravitation, we derive a new encouragement to adopt the sublime belief, that all physical phenomena could be contemplated by a sufficiently high intelligence as consequences of one harmonious system of intelligible laws, ordained by the Author and Upholder of the universe; perhaps as the manifold results of one such mathematical law.

But if those profound and abstract works, in which so large a part is occupied by purely mathematical reasoning, suggest more immediately the thought of that great intellectual consummation, we must not therefore overlook the claims of experimental and practical inquirers, nor forget that they also have an important office to perform in the progress of human knowledge; and that the materials must be supplied by them, though others may arrange and refine them. Especially does it become important to call in the aid of experimental research, when facts of a primary and (so to speak) a central character require to be established; above all, if the establishment of such facts has been attempted in vain, or with only doubtful success, by

eminent experimentalists already. Now, in the theory of heat, the research of the specific heats of the gases is one not far removed from such primary or central position, being no mere question of detail, but intimately connected with the inquiry into the nature of heat itself; it is also one which has been agitated by eminent men, and results have been obtained by some, and disputed by others, of which it is interesting, in a high degree, to examine the correctness or invalidity. For a new examination of this kind, conducted by new methods of experiment, the present award has been made. Of the nature and grounds of this award, I now proceed briefly to speak; and first, it may be proper that I should remind the Academy of the meaning of this phrase *specific heats*, and of the phenomena which suggest the name and the conception.

When any two equal volumes of water at any two unequal temperatures are mixed together, the mixture acquires, in general, a temperature which is either exactly or at least very nearly intermediate between the two original temperatures, being as many degrees of the thermometer below the one, as it is higher than the other. But if a pint of mercury at 60° and a pint of water at 80° be brought in contact and acquire thereby a common temperature, it is found that this last is not so low as 70°; and that thus, this passage of heat, from the warmer water to the colder mercury, has cooled the former less than it has warmed the latter, as indicated by the degrees of a thermometer. Phenomena of this kind suggest the conception, that only a part of the heat contained at any one time, in any particular body, affects the senses or the thermometer; and that the remainder of the heat is insensible, latent, or hidden: so that water, for example, absorbs or hides more heat than the same bulk of mercury at any temperature common to both, and that for any given increase of that temperature (measured by the thermometer) the former absorbs or renders latent more than the latter, while, on the contrary, in cooling through any given number of degrees, it sets a greater quantity free. Many other phenomena are made intelligible by such a conception, and even more immediately suggest it. Thus, if we put a pound of freshly frozen ice in contact with a pound of water, which is warmer than it by about 140° of Fahrenheit's thermometer, the result will be two pounds of water, not at an intermediate, but at the

lower temperature; the excess of heat of the originally warmer water having been all employed in the mere act of melting the ice, or having all become insensible or latent, in the new water formed by melting it. And the principle that heat is absorbed or rendered latent in the production of steam from water, but is given out or set free again when the former is condensed into the latter, is part of the theory of the steam-engine. But because this phraseology suggests a view of the intimate nature of heat, which is at most hypothetical only, it has by many persons been thought better to use the word *specific*, instead of *latent;* and to speak of the specific heats of bodies in a sense analogous to that in which we speak of their specific gravities, to express only certain known and measurable properties of these bodies, in relation to the unknown principle of heat. And thus we say, that water has a greater *specific heat* than mercury, implying only that, whatever be the reason, any given bulk or weight of water produces a more powerful heating effect than is produced by the same bulk or weight of mercury, when both are cooled through the same number of degrees, by contact with a body of a lower temperature.

The specific heats of solids and of liquids are comparatively easy of determination; but the great rarity or lightness of the gases renders the measure of their specific heats more difficult. The former may be investigated with much accuracy, by the aid of Laplace's calorimeter: which is an instrument for measuring (by weight) the quantity of ice that is melted by the heat produced or set free in the cooling of a given weight of the proposed solid or liquid body through a given range of temperature. But in applying the same method to the latter question, that is to the inquiry into the heats of the gases, it appears to be difficult to disentangle the small effect of this sort produced by the cooling of any moderate bulk of gas from the effect produced by the cooling of the envelope in which that gas is contained. Several other methods also of inquiry into this delicate subject, however ingeniously devised and carefully executed, by men of deservedly high reputation, have been considered liable to the same or to other objections, and have failed to inspire any general confidence in their results. It seems, however, that the problem has been at length, to a great extent, resolved, by the employment of that other method, which was invented a

few years ago by Dr. Apjohn here, and elsewhere by Dr. Suerman;* and which may be said to consist in determining, (indirectly,) through the help of a thermometer with moistened bulb, the weight of gas which is required for the conversion (at a known temperature and under a known pressure) of a known weight of water into vapour, by cooling through a number of degrees which is known from observation of another thermometer.

The general theory of the evaporation hygrometer, or the manner of employing a thermometer with moistened bulb, to discover the amount of moisture which is contained at any given time in the atmosphere, was very well and clearly set forth by Mr. (now Sir James) Ivory, in Tilloch's Philosophical Magazine for August, 1822. The same theory was also discovered by M. August of Berlin, with the date of whose work upon the subject I am unacquainted, having only seen the extracts made from it in M. Kupffer's Meteorological and Magnetical Observations, (published at St. Petersburgh in 1837,) and in a recent volume of M. Quetelet's Correspondence. It appears, indeed, that M. Gay Lussac had prepared the way for this discovery, by his researches on the cold of evaporation; and the laws of the elastic force of vapour, and of its mixture with the gases, without which the theory could not have been constructed, are due to the venerable Dalton. Notwithstanding all that had thus been done, the subject seems to have attracted little general notice in these countries, until it was recommended to the attention of scientific men at the first meeting of the British Association; and Dr. Apjohn, who was thus led to examine it anew,† was not aware of the results that had been already obtained. He thus arrived at a new and independent solution, of which he had the satisfaction of testing the correctness, by several different series of experiments; and this success encouraged him to extend the research, and to apply the same principles and methods to other gases, and not to atmospheric air alone.

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* Dissertatio Physica Inauguralis de Calore Fluidorum Elasticorum Specifico; auctore A. C. G. Suerman: Trajecti ad Rhenum, 1836. An excellent work, to which every student of this subject must refer.

† It appears that another Member of the Academy, Dr. Henry Hudson, was also led, by this recommendation, to consider this interesting subject.

He perceived that whatever the gas* might be, in a current of which was placed the thermometer with moistened bulb, the minimum or stationary temperature of that thermometer must be attained when just enough of heat was given out in cooling, by each new portion of gas, to cause the evaporation of that new portion of moisture with which this gas was at the same time saturated; and that thus the amount of depression would vary inversely as the specific heat of the gas, all other circumstances being the same. He investigated, however, the allowances that should be made for variations in such other circumstances, and took all other precautions which his experience pointed out to be important. The consequence has been a new determination of the specific heats of several different gases, on which it seems that much reliance may be placed, from the nature of the method, and from the agreement of the partial results with each other, and with those of Dr. Suerman, though some of these results differ widely from those obtained by methods previously employed; the specific heat of hydrogen, for instance, being found by Apjohn and Suerman, to be, under equal volumes, greater than that of atmospheric air in the ratio nearly of seven to five; whereas some former experimenters had supposed it to be equal or inferior. And by such results the law which had been thought to be obtained by a former eminent observer, namely, that all the simple gases have, under equal volumes, the same specific heat, appears to be overthrown. It is impossible not to feel some degree of regret, when we are thus compelled to abandon a view which had recommended itself by its simplicity, and had been found to be in at least partial accordance with facts; but besides that the search after truth is the primary duty of science, the whole tenor of scientific history assures us, that each new seeming complexity, or apparent anomaly, which the study of nature presents, is adapted ultimately to lead to the discovery of some new and higher simplicity.

A somewhat more distinct conception than the foregoing remarks

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* Dr. Suerman states, that M. Gay Lussac perceived that the specific heat of any gas must be connected with the degree of cold produced by the evaporation of a liquid placed therein; but the remark appears to have been merely made in passing, and to have been afterwards neglected and forgotten.

may have given, of the nature of Dr. Apjohn's method, may be attained by a short study of that first experiment described by him, in which it was found that in a stream of dry hydrogen gas, in which a thermometer with a dry bulb stood at 68°, the one that had the moistened bulb was cooled to 48° of Fahrenheit; the barometer indicating at the same time an atmospheric pressure of 30.114 inches. From the stationary state to which the second of these two thermometers had been reduced, it is clear that the continual supply of heat, required for the continuing evaporation of moisture from the bulb, was supplied neither from the water with which that bulb was moistened, nor from the mercury which it contained, but only from the stream of warmer gas which continued to pass along it; the small effect of radiation from surrounding bodies being neglected in comparison herewith. Each new portion of the current of hydrogen, in cooling from 68° to 48°, must therefore have given out very nearly the precise amount of heat absorbed by that new portion of moisture, which passed at the same time from the state of water to the state of vapour, at the temperature of 48°. It is also assumed, apparently upon good grounds, that after the moist bulb attains its stationary temperature, the whole (or almost the whole) of the new gas, in becoming *fully cooled*, becomes at the same time *fully moistened*, or *saturated* with the new vapour; this vapour being intimately mixed with the gas which had assisted to form it; and every cubic inch of this mixture containing exactly (or almost exactly) as much moisture as a cubic inch *could* contain, in the form of vapour, at its own temperature: a quantity which is known from the results of Dalton, respecting the elastic force of vapour. From those results it follows, that in the present case, the temperature of the vapour being 48°, its elastic force must have been such that it could by itself have supported the pressure of a column of mercury, 35 hundredths of an inch in height; but the pressure upon the mixture was equivalent to a column 30 inches and 11 hundredths high; therefore the pressure which could have been supported by the hydrogen alone, at the same temperature of 48°, was equivalent to 29 inches and 76 hundredths: so that, by the known proportionality between density and pressure, the weight of the gas which was contained in the whole or in any part of this mixture would have exceeded the weight of the vapour in the

ratio of 2976 to 35, or in the ratio nearly of 85 to 1, if the weight of a cubic inch of hydrogen gas were as great as that of watery vapour, under a common pressure, and at a common temperature. But under such circumstances, a cubic inch of vapour weighs about nine times as much as a cubic inch of hydrogen; we must therefore divide the number 85 by 9, and we find that in the present case the mixture contained only about $9\frac{1}{4}$ grains of hydrogen for every grain of vapour; and thus we learn, from this experiment, that the heat required for the evaporation of a grain of water at the temperature of 48° might be (and was in fact) supplied by the cooling of about $9\frac{1}{4}$ grains of hydrogen from 68° to 48°. But in order to produce the same amount of evaporation by the heat which water would give out, in cooling through the same range of temperature, it is known from other experiments that it would be necessary to employ about 56 grains; therefore $9\frac{1}{4}$ grains of hydrogen have nearly as much heating power as 56 grains of water, or one grain of the former contains almost as much specific heat as six grains of the latter. All this is stated in round numbers, and with the omission of all lesser corrections, for the sake merely of such members as may not have attended to the subject, and yet may wish to have a clear, though general notion of it. Those who desire a more exact account will, of course, turn to the Essay itself.*

With respect to those independent, but analogous researches of

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* The formula given by Dr. Apjohn for the general solution of the problem of the moist bulb hygrometer, in any gaseous atmosphere, is,

$$f'' = f' - \frac{48ad}{e} \times \frac{p}{30};$$

in which e is the caloric of elasticity of vapour, at the temperature t' of the hygrometer; p is the atmospheric pressure; d is the difference between the temperatures of the dry and wet thermometers: f' and f'' are the elastic forces of the vapour of water, at the temperature of the hygrometer, and at that other temperature at which dew would begin to be deposited; and a is the specific heat of the gas, compared with that of an equal weight of water, and multiplied by the specific gravity of the same gas, compared with that of atmospheric air. For the case of a current of dry gas $f'' = o$, and

$$a = \frac{ef'}{48d} \times \frac{30}{p};$$

in which, as also in the other formula, it would be a little more exact to write $p-f'$ instead of p. A correction is given for the case of a mixture of gas with air; and the influence of other corrections also is taken into account. When a is divided by

Dr. Suerman,* to which allusion has been made, they seem (as has been said) to confirm as closely as could be expected, under the differing circumstances of the experiments, the results of Dr. Apjohn ; of whose labours, indeed, that eminent foreigner has spoken in the most handsome terms, and in favour of whom he has freely waived, upon this subject, all contest for priority. But even if among the many persons who now are cultivating science in many distant countries, and whose results are sometimes long in coming to the knowledge of each other, it should be found that some one has anticipated our countryman and brother academician in the publication or invention of the method which I have endeavoured briefly to describe to you, or if, on the other hand, his own future reflections and experiments, or those of any other person, shall indicate hereafter the necessity of any new improvement, your Council still will have no cause to regret that they have adjudged the present distinction to a paper which contains so much of independent thought, and so much of positive merit.

[*The President then delivered the Medal to Doctor Apjohn, addressing him as follows.*]

Doctor Apjohn,

In the name of the Royal Irish Academy, I present to you this Medal, for your investigations respecting the specific heats of the gases; hoping that it will be received and valued by you, as attesting our sense of the services which you have already rendered to that important and delicate department of physical research; and that it will also be to you a stimulus and an encouragement to pursue the same inquiry further still, so as to improve still more the results already obtained, and to establish other new ones; and thus to connect, more and more closely, your name and our Transactions with the history of this part of Science.

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the known number 0,267 the quotient is the specific heat of the gas compared with that of an equal volume of atmospheric air: and the sensible inequality of the specific heats so found, for different simple gases, is the chief physical conclusion of the paper.

* It is proper to remember that Dr. Suerman published his Dissertation without having seen the last and most correct results of Dr. Apjohn, contained in the present prize Essay. This remark applies particularly to the specific heat of hydrogen.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1839. No. 16.

March 16. (Stated Meeting.)

SIR Wm. R. HAMILTON, A. M., President, in the Chair.

This being the day appointed by Charter for the annual election, the following Officers and Members of Council were chosen for the ensuing year:

President—Professor Sir Wm. Rowan Hamilton, A. M.
Treasurer—Thomas Herbert Orpen, M. D.
Secretary—Joseph Henderson Singer, D. D.
Secretary to Council—Rev. Humphrey Lloyd, A.M.
Secretary of Foreign Correspondence—Sir Wm. Betham.
Librarian—Rev. William Hamilton Drummond, D. D.

Committee of Science.

Rev. Franc Sadleir, D. D. Provost of Trinity College; Rev. Humphrey Lloyd, A.M.; James Apjohn, M.D.; James Mac Cullagh, LL.D.; William Stokes, M. D.; Rev. William Digby Sadleir, A. M.; Robert Ball, Esq.

Committee of Polite Literature.

His Grace the Archbishop of Dublin; Rev. Joseph H. Singer, D. D.; Samuel Litton, M. D.; Rev. William H. Drummond, D. D.; Rev. Charles Richard Elrington, D. D.; Rev. Charles William Wall, D. D.; Rev. Thomas H. Porter, D.D.

Committee of Antiquities.

Thomas Herbert Orpen, M. D.; Sir William Betham; George Petrie, Esq.; Rev. Cæsar Otway, A. B.; the Very Rev. the Dean of St. Patrick's; Rev. James Henthorn Todd, B. D.; Henry J. Monck Mason, LL.D.

The President under his hand and seal appointed the following Vice-Presidents:

His Grace the Archbishop of Dublin; the Provost; Samuel Litton, M. D.; Rev. Humphrey Lloyd, A. M.

The Committee appointed to examine the Treasurer's Accounts reported as follows:

"We have examined the above Account,* with the vouchers produced, and have found it to be correct; and we find that there is a balance in bank of £160; and in the Treasurer's hands £112 6*s*. 10*d*., making a total balance of £272 6*s*. 10*d*. sterling.

"(Signed,)

"Franc Sadleir,
"Samuel Litton."

"*March 9th*, 1839."

"The Treasurer reports that there are the following portions of Stock in the Bank of Ireland to the credit of the Academy:

"£1500 in 3 per Cent. Consols.

"£1500 in 3½ per Cent. Government Stock, being the Cunningham Fund.

"(Signed,)

"Franc Sadleir,
"Samuel Litton."

"*Dec. 31st*, 1838."

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* Entered in the Treasurer's Book.

Dr. Apjohn read a paper on the Analysis of the Water of the Dead Sea.

After some general remarks upon the geographical position, extent, and depth of the Dead Sea, the geological structure of the surrounding country, and the different statements handed down by the older historians, and to a certain extent corroborated by modern travellers, in reference to the excessive density of its waters, and the absence from them of living things, both animal and vegetable, Dr. Apjohn gave a historical sketch of the analytical researches, in reference to this water, of Lavoisier, Marcet, and Klaproth.

The specimen which he examined, he stated to have been recently brought to this country by George James Knox, Esq., from Syria, and to have been committed to him for analysis by the Rev. Thomas Knox, both members of the Academy, and authors of valuable scientific communications, read at our meetings, or published in our Transactions. A number of experiments were now detailed, having for their object to determine the nature of the saline constituents of the water, and illustrate its composition and properties. Its specific gravity was set down as 1153, and its boiling point as 221°. Its contained salts were enumerated as sulphate of lime, chloride of calcium, chloride of magnesium, bromide of magnesium, chloride of potassium, chloride of sodium, chloride of manganese, and sulphate of lime; the chloride of potassium and manganese, and the bromide of magnesium having, as he thought, up to the time of the completion of his analysis, been first detected by himself. It held in solution an unusually small amount of air.

The following is an outline of the method of analysis employed.

To approximate to the quantity of saline matter, a known weight of the water was evaporated to dryness, and finally heated to about 400°. The residuum amounted to 18.91 per cent.

During the evaporation, a portion of the chloride of magnesium was decomposed, and water being poured on, the amount of magnesia left undissolved was determined.

To the solution, oxalate of ammonia was added in excess, by which the lime was obtained; and, this being separated, the remainder of the magnesia was insulated in the usual manner, by boiling with carbonate of potash, evaporating to dryness, &c.

To check the determination of the magnesia, the following method was taken. A known weight of the water was boiled with excess of lime, by which the magnesium and manganese were separated and replaced by calcium. The amount of this latter metal (the free lime being, of course, first removed by carbonic acid, boiling, &c.) was then determined by oxalate of ammonia, and subtracting from it the calcium of the water as previously determined, the remainder was the calcium which replaced the magnesium and manganese. This remainder (the manganese being present in very minute proportion) was found to be almost exactly what it should be, supposing it to replace nothing but magnesium, or it was to the magnesium directly determined in the ratio of the atomic weights of the two metals.

The solution, deprived of magnesia, lime, and manganese, was now evaporated to dryness, and ignited so as to expel the ammoniacal salts, and the residue gave the mixed chlorides of potassium and sodium, with a trace of sulphate of potash. The quantity of chloride of potassium in this mixture was determined in the usual way, by the bichloride of platinum, and the difference gave the chloride of sodium. The numbers thus obtained, some spattering having occurred during the expulsion of the ammoniacal salts, were looked upon as only relatively true, and were corrected in the following manner.

The chlorine and bromine having being determined, as shall be presently described, as also the different metals,

with the exception of the alkaline ones, and the bromine being supposed united with magnesium, and a deduction made from the calcium for the small amount of sulphate of lime present, it was easy, by giving to the manganese and earthy metals their proper proportions of chlorine, to infer the quantity of this principle united with the potassium and sodium. Let this quantity, which was found greater than what resulted from the direct determination of the chlorides of these metals, be called w, and let m be to n in the ratio of the chloride of potassium to the chloride of sodium, as already determined. Let x, also, be the true weight of the chloride of potassium, y the true weight of the chloride of sodium, a the ratio of the atomic weight of chloride of potassium to chlorine, and b that of chloride of sodium to chlorine. We will thus obviously have the two following equations:

$$an + by = w; \text{ and, } nx = my;$$

from which we readily deduce

$$x = \frac{mw}{ma + nb}; \text{ and } y = \frac{nw}{ma + nb}.$$

From a fresh portion of the water the sulphuric acid was got by nitrate of barytes, and the sulphate of barytes having been separated, the chlorine and bromine were thrown down in union with silver.* To infer, however, from this mixed precipitate, the chlorine, it was necessary to estimate the bromine present by a distinct process.

With this view, a strong aqueous solution of chlorine was mixed with a known weight of the water under analysis, and the bromine liberated was removed by repeated washings with ether. From the etherial solution, the bromine mixed with some chlorine was separated by barytic water, and the ether being distilled off, the residue was evaporated to dryness, and ignited, so as to reduce any bromate and chlorate

* The excess of silver having been separated from the solution, by chloride of sodium, the manganese was thrown down by the addition of hydrosulphate of ammonia. This metal was also estimated by the process recommended by Stromeyer.

of barytes formed to bromide and chloride of barium. These salts were dissolved in water, deprived by carbonic acid and boiling of free barytes; again evaporated to dryness, ignited, and accurately weighed. Water being poured on, they were re-dissolved, and converted, by the addition of nitrate of silver, into a mixture of the bromide and chloride of silver, which was also accurately weighed. Now, if w be the weight of the mixed bromide and chloride of barium, w' that of the mixed bromide and chloride of silver, x the chlorine, y the bromine, m the ratio of the atomic weight of chloride of barium to chlorine, n that of the atomic weight of bromide of barium to bromine, m' the ratio of the atomic weight of chloride of silver to chlorine, and n' that of the atomic weight of bromide of silver to bromine, we will have the following equations:

$$mx + ny - w, \quad \text{and } m'x + n'y = w',$$

from which we get

$$y = \frac{mw' - m'w}{mn' - m'n}.^{*}$$

Having thus obtained the bromine, the chloride was easily inferred from the mixed chloride and bromide of silver, already got by adding nitrate of silver to the water. The following are the final results.

Chloride of calcium,	2.438	
Chloride of magnesium,	7.370	
Bromide of magnesium,	0.201	
Chloride of potassium,	0.852	= 18.78.
Chloride of sodium,	7.839	
Chloride of manganese,	0.005	
Sulphate of lime,	0.075	
Water,	81.220	
	100.	

* This method answers well, the atomic weight of bromine being so much greater than that of chlorine, and is susceptible of far greater accuracy than any more direct one, having for its object the insulation of the bromine.

When the analysis was completed, with the exception of the quantitative determination of the bromine, Dr. Apjohn became aware that in the discovery in the water of the Dead Sea of the potassium, manganese, and bromine, he had been anticipated by M. C. G. Gmelin, who has assigned to it the following composition.

Specific gravity = 1212.

Chloride of calcium,	3.2141	= 24.5398.
Chloride of magnesium,	11.7734	
Bromide of magnesium,	0.4393	
Chloride of potassium	1.6738	
Chloride of sodium	7.0777	
Chloride of manganese	0.2117	
Chloride of ammonium,	0.0896	
Chloride of aluminum,	0.0075	
Sulphate of lime,	0.0527	
Water,	75.4602	
	100.	

After having seen this analysis, Dr. Apjohn stated, that he again looked for alumina and ammonia, but could not detect the slightest trace of either. The quantities, however, of these principles found by Gmelin were so small, that their non-appearance in Dr. Apjohn's analysis cannot be considered as a material discrepancy. But there are other striking differences.

The density of the specimen examined by Gmelin, and its percentage of saline matter were considerably higher than those which belonged to the water analyzed by Dr. Apjohn, a circumstance easily accounted for, by the fact of the latter having been collected about half a mile from the embouchure of the Jordan, and towards the close of the rainy season. But notwithstanding this, it might have been anticipated, that the results of both for the different salts should be relatively the same; such, however, is far from

being the case. The ratio of the chloride of magnesium to the chloride of calcium is much greater, and of the chloride of sodium to the chloride of potassium, much smaller with Gmelin than with Dr. Apjohn. The quantities also of the bromide of magnesium and chloride of manganese, as determined by Gmelin, are, as respects Dr. Apjohn's numbers, disproportionately great, and, what is very singular, the amount of the chloride of sodium obtained by Gmelin is absolutely less than that got by Dr. Apjohn, though the total amount of saline matter in the water examined by the former, is to that in the specimen examined by the latter, very nearly in the ratio of 4 to 3.

It is not easy to explain such discrepancies, but assuming both analyses as correct, we arrive at the conclusion, that the waters of the lake in question are subject to a variation of constitution, affecting not only the relation of the saline matter to the water, but the proportions also which the different salts bear to each other.

Mr. Bergin exhibited to the Academy, the results of some experiments with photogenic paper, prepared after the method of Mr. Talbot.

RESOLVED,—That the Academy do condole with the family of Dr. Perceval, one of the original Members of the Academy, and its first Secretary; and that the Secretary be requested to draw up the expression of its condolence.

RESOLVED,—That the thanks of the Academy be given to the Marquis of Normanby for the manuscript of the late General Vallancey, presented by him to the Academy; and that the President be requested to communicate the same.

DONATIONS.

Manuscript Volume of the late General Vallancey. Presented by the Marquis of Normanby.

The Rights of Animals. By the Rev. W. H. Drummond. Presented by the Author.

Astronomical Observations made at the Cambridge Observatory, by the Rev. James Challis, M. A. Presented by the Author.

Tables of Logarithms. Presented by the publishers, Messrs. Taylor and Walton of London.

Political Medicine. By T. H. Maunsell, M. D. Presented by the Author.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Par MM. les Secretaires Perpetuels. Nos. 2—7. Premier Semestre, 1839. Presented by the Academy.

April 8.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Thomas Rhodes, Esq., and John U. Owen, M. D., were elected Members of the Academy.

Professor Lloyd laid on the table of the Academy, the apparatus for experiments on the rectilinear, elliptic, and circular polarization of light, invented by M. Dove of Berlin; also two sets of Fraunhofer's gratings, presented to him by Edward Cooper, Esq. M.P., by whom they were brought from Munich.

Dr. Wilde, a visiter, by permission of the Academy, read a paper on some Discoveries he had made at Tyre, relating to the manufacture of the celebrated Purple Dye.

Dr. Wilde stated, that having been engaged in investigating the ruins of Tyre, he discovered several circular apertures or reservoirs cut in the solid sandstone rock close to the water's edge along the southern shores of the peninsula. These in shape resembled a large pot, and varied in size from two to eight feet, in diameter and from four to five deep; some were in clusters, others isolated, and several were connected in pairs by a conduit about a foot deep. Many of those reservoirs were filled with a breccia solely composed of broken up shells, bound together by carbonate of lime, and a small trace of strontian; large heaps of a similar breccia were found in the vicinity of the pots. This mass, a portion of which Dr. Wilde exhibited to the Academy, is exceedingly heavy, of adamantine hardness, and the shells of which it is composed appear to be all of *one* species, and from the sharpness of their fracture, were evidently broken by art and not worn or water washed. The portions of shell were examined by eminent naturalists, and are pronounced to be the *murex trunculus*, which most conchologists agree was one species from which the Tyrian dye was obtained, but until now, no *proof* could be given of its being the actual shell.

Dr. Wilde is of opinion, that the reservoirs he discovered were the vats or mortars in which the shells were broken up, in order to obtain the dye (which lies in a sac in the neck of the mollusc inhabiting them,) and showed that it accurately accords with the description of Pliny, who states, that the smaller shells (of which those in the specimen are examples) were broken in "*certain mills.*"

Dr. Wilde exhibited some ancient spear heads, the property of Lord Lorton, found in the County of Roscommon.

RESOLVED, (on the recommendation of Council,)—That certain defaulters, owing five years' subscription and upwards

on the 16th of March last, be declared to be no longer Members of the Academy.

RESOLVED,—That the new device, proposed by Sir W. Betham for the Seal of the Academy, be adopted, and that the thanks of the Academy be given to Sir W. Betham.

DONATIONS.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Nos. 8—9, 1839. Presented by the Academy.

Abhandlungen der Königlichen Academie der Wissenschaften zu Berlin, for 1833. Also, *Uber die Länderverwaltung unter dem Chalifate, von Joseph von Hammer,* 1835. Presented by the Royal Academy of Berlin.

Statistique de la France 1835. (*Commerce Exterieur.*) Presented by Mons. Moreau de Jonnes.

Dr. Walsh's Constantinople. Presented by the Author.

Walsh on early Christian Coins and Gems. Presented by the Author.

Dr. Walsh's Journey from Constantinople. Presented by the Author.

First Annual Report of the Dublin Natural History Society, 1839. Presented by the Society.

Catalogue of the Library of the Royal Dublin Society, 1839. Presented by the Society.

Transactions of the Geological Society of London. Vol. V. Part I. Presented by the Society.

Report on the Geology of Cornwall, Devon, and West Somerset; by Henry T. de la Beche, F. R. S. Presented by the Lords Commissioners of the Treasury.

April 22nd, 1839.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The Rev. Dr. Walsh read a paper on a Sepulchral Urn and Stone Coffin found in the Parish of Kilbride, with some notices of the Parish.

The union of Kilbride, county of Wicklow, consists of four parishes, forming a triangular area of fifteen miles in circumference, bounded by the River Ovoca, the sea coast, and a line drawn from one to the other. The Irish language is entirely extinct among the peasantry, and though the names of places and particular objects are very expressive in that language, they are altogether unintelligible to the people. Not an individual among them can speak a word of their native tongue. The majority are of the reformed religion, English colonists located in this maritime district, after the wars of Elizabeth, Cromwell, and James. They preserve many traditions of their achievements; one family kept a sword taken from the last tory seen in the county, whom they killed. It had six pounds of brass in the hilt, obtained perhaps from the copper mines of Cronebane, long before they were regularly worked. The people are serious and religious, and distinguished for their moral qualities, dishonesty is unknown among them, and their sobriety is such, that there is not a public house in the union of fifteen miles in extent, nor did Dr. Walsh remember to have ever seen in the parish a drunken man on Sunday.

The land is divided by a ridge of hills rising through the centre, dividing it into the Vale of Ovoca and the Vale of Redcross. This ridge affords many lovely prospects from its summit. One was compared by Dr. Pococke to the view he had seen of the Vale of Nazareth, from the ridges of Mount Lebanon. The sea shore is a level strand, lined with

sand hills, thrown up from the sand constantly dropped from the great submerged banks which lie along the Wicklow coast. Those near the mouth of the Ovoca are distinguished for their fertilizing property. They were found to contain immense quantities of human bones in a state of decomposition. Many battles are recorded as fought in this place, and the hills here seem tumuli raised over the bodies of the slain.

In other places the sand banks are covered with a rich sward, which seems to rest upon a soil as firm as any other land. It was suggested by a gentleman, to employ the peasantry of the neighbourhood in weaving the sedge, and other marine plants, into mats and baskets. When they were cut away for this purpose, the hills, losing the tenacity they afforded, began to move, and have continued to do so, changing the whole face of the country, covering up farms and houses, and converting the townland, like Bannow, into another Irish Herculaneum.

The ridge of the hill affords many remains of remote antiquity, some are blocks of stone fifteen feet in length, laid parallel to each other, resembling burying places made for men of gigantic stature. Beside one of these, a curious discovery was recently made. A farmer was raising stones in a wild and solitary part of the mountain, to fill up gaps; about two feet below the surface, he turned up a flag, under which was a stone coffin, containing an urn in an inverted position, under which were two small bones laid parallel to each other. The coffin, consisting of six flags, was eighteen inches long, the sides seven inches high, and ten broad, put together with neatness, the corners rectangular, and the sides perpendicular; the inside perfectly clean, and free from dust or mould. The urn was four inches deep, swelling in the middle, and contracting at both ends. It was rudely but neatly sculptured with great care; the bones were very small, but perfect, having articulations at both ends, and were pronounced to be

joints of human fingers and toes. The urn was procured by Dr. Walsh, then incumbent of the parish, and was in high preservation, but when he endeavoured to move the stone coffin, it broke into fragments, which he gathered up, and had a good model of it made in wood, by a country carpenter on the spot.

Dr. Walsh concluded his communication in the following words. "The mode of sepulture by such urns and stone coffins is too common to trouble the Academy with details of them. Many are recorded in their own Transactions; but I cannot find that an urn in a stone coffin, inverted over two bones of the human fingers, has before been discovered or described. I have searched various archæological works, and can find no such thing. It only remains for me, therefore, to present to the Academy the urn and model of the coffin, &c. if they deem them worth their acceptance, and leave it to some more intelligent and industrious member to pursue the inquiry."

In a conversation which arose after the reading of this paper, the Rev. Cæsar Otway gave an account of a visit which he made, in company with the Dean of St. Patrick's, to the same district; and related some anecdotes of the opening of tumuli in other parts of Ireland. Mr. Otway suggested, that a deputation should be sent from the Academy to superintend the opening of some ancient cairns, with a view to obtain a more accurate account of their contents, than can be expected when they are opened accidentally or by peasants.

Mr. Petrie made some remarks on the historical interest of the Cairns in Ireland, most of which are noticed in the Irish annals, and strongly recommended that Mr. Otway's suggestion should be acted on.

The Secretary of Council read the following notice of a Compound of Fluorine and Carbon, by George J. Knox, Esq.; communicated in a letter to Dr. Apjohn.

" When a current of dry chlorine gas is passed over fluoride of silver fused in a platinum tube, the extremity of which fits into a platinum receiver immersed in a freezing mixture, the fluoride of silver is decomposed, being converted into chloride of silver, and no solid or liquid substance is found in the receiver. When, however, in place of chlorine, the vapour of liquid chloride of carbon (serrulas) is substituted, the fluoride of silver is decomposed, and the receiver is found to contain acicular crystals, which are insoluble in water, acids, and alkalies, sparingly soluble in alcohol and ether, but very soluble in spirits of turpentine. When heated in a platinum crucible, they sublime unaltered, emitting a strong aromatic odour; their vapour does not affect the colour of litmus paper. When a cold glass plate is placed over the mouth of the platinum crucible, the crystals subliming condense upon the glass, and acting upon it, engrave upon its surface a beautiful outline of their form. Ignited in a closed platinum vessel, they are decomposed, depositing charcoal.

" When the vapour of chloride of carbon is passed over iodide and bromide of silver fused in glass tubes, analogous compounds are formed; the one in the form of long needles, the other of feathery crystals. Both sublime unaltered when heated; are insoluble in water, acids, alkalies, alcohol, and ether; but soluble in warm spirits of turpentine and chloride of carbon.

" I have failed twice in obtaining a sufficient quantity of the crystals for analysis, and so send you the paper as it is. The first time I obtained 20 grs. which would have been enough, but I lavished it in determining its qualities. I had intended analyzing it by burning it with deutoxide of copper in a leaden tube, estimating the carbonic acid by the increased weight of potash, and throwing down the fluorine

from the dissolved contents of the tube by lime. Is this method preferable to burning it with silica; conveying the fluosilicic acid into ammonia, and estimating by the weight of silica?"

The Secretary read a second notice by the same author, on a supposed fluoride of nitrogen.

"Having transferred a drop of chloride of nitrogen into a platinum capsule containing a little water, on adding to the water an aqueous solution of fluoride of silver, a gas was freely evolved, somewhat resembling chlorine in smell, but of so pungent a nature, and so exceedingly irritating to the eyes, that I was unable to approach near enough to determine any of its properties, although my eyes were protected by a mask and spectacles. When the gas had all escaped, the capsule was found to contain chloride of silver, fluoride of silver and water, and had not been sensibly heated by the intense chemical action which had taken place.

"Again, on adding to a portion of dry fluoride of silver contained in a platinum dish, a drop of chloride of nitrogen, so violent an explosion took place, that the platinum dish was torn as if it had been made of parchment, and a considerable part of it blown away."

Mr. Robert Mallet communicated a notice of the discovery of the property of the light emitted by incandescent coke to blacken photogenic paper; and proposed it as a substitute for solar light, or that from the oxy-hydrogen blowpipe with lime.

One of the most important applications of the photogenic process, as yet suggested, is its adaptation to the self registering of long continued instrumental observations. Unless, however, an artificial light, of a simple and inexpensive character, can be found to supply the place of solar light at night, the utility of this application will be much limited.

Few artificial lights emit enough of the chemical rays to

act with certainty on the prepared paper; while those which are known to act well, as the oxyhydrogen lime light, are expensive, and difficult to manage. A considerable time since, the author discovered that the light emitted by incandescent coke, at the "Twyer" (or aperture by which the blast is admitted) of a cupola or furnace for melting cast iron, contained the chemical rays in abundance; and on lately trying the effect of this light on the prepared paper, he found it was intensely blackened in about forty-five seconds. In the single experiment made, the heat, which was considerable, was not separated from the light; but the author purposed to make further experiments, in which this precaution will be attended to.

There is no difficulty to be apprehended in contriving an apparatus to burn a small quantity of coke at a high temperature. A diagram of an apparatus for this purpose was shown. It consists of a vertical tube, nine inches in diameter, lined with refractory clay, and closed at top and bottom. There is a grating about one foot from the bottom, a little above which are two opposite holes, into one of which an air blast from a revolving fanner is projected through the coke, with which the whole tube is filled. The flame passes out at the opposite hole, through a tube so contrived, as to heat the blast of air to a temperature of 500°, just before it enters the coke fire.

The light from the former lateral aperture is that proposed to be used, and issues through a plate of mica or glass opposite to it. This aperture forms part of the conductory tube for the blast, which (by passing into the coke in a direction opposite to that in which the light is emitted) keeps the illuminating surface of coke clear from ashes; these are received below the grating, and by a diversion of part of the blast, are blown into the chimney which receives the other products of the combustion.

As the vertical tube is close above, the combustion can-

not proceed upwards, while the coke with which it is filled constantly drops down to supply the place of that consumed, on the principle of the ancient furnaces, called "athanors" by the earlier chemists.

The only difficulty to be apprehended in the use of coke, is the collection of slag, from the fusion of its earthy and ferruginous constituents; however the author does not consider that this accumulation during the period from sunset to sunrise, in mid-winter, would materially interfere with its action.

The Treasurer presented the account for the year ending March 31, 1839.

Ordered to be entered on the minutes, and published in the Proceedings.

Ordered,—That the Seal of the Academy be affixed to the Treasurer's Accounts.

FOR THE YEAR ENDING MARCH 31st, 1839.

THE CHARGE.

	£ s. d.	£ s. d.
Balance in favour of the Academy, April 1st, 1838	. . . .	227 8 3
Parliamentary Grant, Session 1838	300 0 0	
Treasury warrants for Rent and Taxes	146 17 8	446 17 8
Transactions sold	4 15 6	
Mr. Boone, London Bookseller, do.	17 4 7	
Hodges and Smith, two years	4 9 4	26 9 5
One year's interest on £1500, 3½ Gov. Stock	52 10 0	
Do. do. 3 per Cent. consols	45 0 0	97 10 0
One year's rent of stable	. . . .	21 0 0
Subscriptions, Life Compositions	186 18 0	
Entrance	162 15 0	
Annual, and Arrears	239 8 0	589 1 0
Total		£1408 6 4

THE DISCHARGE.

	£ s. d.	£ s. d.
Coals, Candles, &c.	55 19 9	
Repairs of House, Furniture, &c.	137 7 8	
Rent, Taxes, and Insurance	159 18 5	
Books, Printing, and Stationary	529 16 10	
Cunningham Medals	39 10 0	
Salaries, Servants' Wages, &c.	295 4 1	
Contingencies	59 17 10	
Total Discharge	. . . .	1277 14 7
Balance in favour of the Academy	. . . .	130 11 9
Total		£1408 6 4

STATE OF THE BALANCE.

In Bank of Ireland, as per Certificate	£70 0 0	
In Treasurer's hands	60 11 9	
Balance as above		£130 11 9

Signed,

THOMAS HERBERT ORPEN, *Treasurer.*

April 22*nd*, 1839.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1839. No. 17.

May 13.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

Edward Conroy, Esq., and Nicholas P. Leader, Esq., were elected Members of the Academy.

Sir James Ivory was elected an Honorary Member of the Academy.

Dr. Wilde read a paper upon the Peruvian mummy, recently opened in Dublin. He stated that Captain Duniam a gentleman in the South American trade, having been informed that a colony of Irish had settled on the western coast some years since, determined on visiting them; and having been hospitably received, was brought on a day's pleasure to a wild spot on the shore, where the party, for his amusement, commenced digging up several mummies, the most perfect of which he brought away. In a letter he says: "This mummy was dug up from the sloping ground, about two miles and a-half south-east of the Morro of Arica, facing to the south-west on the coast of Peru, the soil sandy, in depth about six inches, under which is a layer of saltpetre about eight inches thick, and so very hard that it had to be broken with a pickaxe. Underneath this is a mixture of saltpetre and sand, out of which the body was dug. The face was found turned towards the west, or setting

sun; and all the utensils, pots, &c. were buried with him, forming a semicircle in front."

Tradition reports, that these were the bodies of the ancient Peruvians, buried before the invasion of the Spaniards; and it is also said, that remains similar to those are found on the eastern side of the mountains, having their faces turned to the rising sun, but still in the same sitting posture.

Dr. Wilde then exhibited a drawing by Mr. Wakeman, showing the state in which the mummy had been received, and continued: "This drawing shows the condition in which the mummy was found, bound up in a cloak, or outer garment, fitting so as to give a tolerably accurate idea of the posture in which it was placed; and over this was wrought a net of rushes, or other such substance, with large meshes, in the manner of a purse, wound several times round the neck and ankles, without covering the head or feet."

Dr. Wilde observed, that it was a practice of the ancient Egyptians to bind their mummies tightly round the neck and feet, and produced an example in which the diameter of the neck did not exceed two inches. "On cleaning and repairing this outer garment, cloak, or poncho, it was found to be composed of a complete web of cloth, formed apparently of the wool of the Lama. In texture it resembles several of the specimens of the Egyptian linen which I found in the catacombs at Sakara, the character of which depends upon the great tightness of the threads of the weft, and looseness of the warp, arising from the imperfection of the loom, and use of a ruler instead of a shuttle in weaving—a practice formerly used in Egypt, (as shown by the plates of Rosellini,)—found still extant in Mexico by Dr. Coulter, and noticed by myself in Barbary and Judea."

This garment, which is exceedingly simple in form, consists of a web, doubled and sewn together at the sides, except for a short distance at top, where openings were left for

the arms: One was also made for the head; but when the dress was round the mummy no opening could be perceived. When restored and cleaned, it will serve to illustrate the dress of the ancient Peruvians, and, with the other utensils found buried, will furnish data to determine the state of the arts and condition of this interesting people. These articles consist of fourteen vessels of burned pottery, of different sizes; pipkins, jars with long narrow necks, and globular vessels with small circular openings—some of remarkably fine workmanship, though they do not seem to be made on a wheel—unglazed, bearing the marks of fire, and probably used as cooking utensils by the deceased; remains of a basket of great beauty, so intricately woven as to be capable of holding water, and similar to those still in use in the central parts of Africa; calabashes and rush baskets, interwoven with coloured worsteds; mats of a similar material, and most elaborate workmanship; an ancient Mexican pictorial manuscript or hieroglyphic; ornamental bags, one containing the leaves of some vegetable, and a wampum belt. The variety and brilliancy of the colours are most remarkable; mostly all the textures are woollen. A piece of cloth, woven in stripes of different colours; eight arrows, or bolts; the model of a painted paddle; a piece of fishing line, cable laid, showing great art in its construction; a miniature stake-net, or fishing trammel, similar to those constructed for a like purpose in Ireland. These latter articles lead to the belief that this person was a fisherman.

On the 1st of May the outer garment was removed, in presence of a number of gentlemen, chiefly members of the Academy, who had purchased the mummy by subscription. The body was found in a sitting posture—that, probably, in which the deceased had sat round the council fires of his nation. The head is bent forward, approaching to the knees; the left arm is bent, with the hand turned in upon the chest; around the fingers is worn

a piece of fine fishing-line, and the thumb is turned in on the hand in a remarkable manner—a custom observed by the ancient Hebrews, and still adhered to by the religious Jews of Palestine—namely, to tie the thumb after death into the cleft, between the fore and middle fingers, lest the extended thumb should make the chirogram of "Jehovah," a name they feared to write while living, and were unwilling to express when dead. The hands of Egyptian mummies, which Dr. Wilde produced, were similarly compressed. The right arm is concealed under several bags, filled with some substance as yet unknown; they are large, and similar in construction to those found outside, but exceeding them in colour. On these were placed two vessels of highly ornamented pottery. Vessels of a similar kind are at present used for sipping a kind of tea with a tube, in the very position this mummy now presents. The lower parts of the body and hips were wrapped in folds of striped cloth, which appears to have been a kilt, a sort of garment worn by the ancient Incas of Peru. The feet are clad in sandles, fastened on by thongs of leather. The body was found to be covered with numberless minute shining crystals, probably of an animal nature. The head is particularly remarkable from its shape, and the probable race of mankind to which it belonged. The hair is divided along the whole length of the head, is particularly long, and beautifully plaited. Dr. Wilde also exhibited the head of a young female covered with brown hair, of great fineness, and likewise beautifully plaited, and adorned with small golden ornaments attached to the end of the plaits; over the face was tied a mask of skin.

In reference to an observation of Dr. Pettigrew of London, Dr. Wilde does *not* think the subject was buried alive; and he remarked, that it was in such excellent condition, and so perfectly dry, as to allow of its being very well preserved.

Dr. Wilde concluded by mentioning that Mr. Burton

had produced two beautiful drawings of the mummy; and that both Mr. Wakeman and Mr. Burton had presented their drawings to the subscribers.

The Secretary read a letter from Joseph Lentaigne, Esq., on the subject of a Manuscript Translation of Part of Virgil's Æneid.

"A manuscript, in three volumes, containing the third, fourth, sixth, eighth, ninth, eleventh, and twelfth books of the Æneid, in English verse, has been lately placed in my hands by F. Comyn, Esq., of Woodstock, in the county of Galway, who discovered it among the books of one of his ancestors, formerly a physician at the court of Louis XV. of France. It bears the following date:—" Ended at St. Germains the 18th day of 7ber, 1692;" being two years prior to the commencing of Mr. Dryden's great translation, which (as he informs us) he was " three years doing," and which was completed in 1697. That this manuscript is genuine cannot reasonably be doubted. The orthography, the fabric of the paper upon which it is written, the date of printed papers used in the binding, and many other circumstances, prove that it is the production of the period at which it bears date. The name " Lauderdail" is written on the fly-leaf, and is still legible notwithstanding an attempted obliteration. The author's name is not given; but the Episode of Nisus and Euryalus is marked, " by Mr. Dryden;" that of Camilla, by " Mr. John Stafford;" and, at the end, are the following among other memoranda:—" Eighty-six errors since sent to Mr. Dryden, after Bryarly wrote it; 162 errors corrected since Mr. Bysh wrote this book; 122 errors corrected since Mr. Dallon wrote this book; 486 lines corrected and altered since this book was first sent to Mr. Dryden." It is, therefore, most probably the work of several contributors, but corrected and altered by Lord Lau-

derdale, from whom Mr. Dryden acknowledges to have received from abroad his lordship's new translation of Virgil, two years before he himself engaged in the same design, and which he consulted as often as he doubted of his author's sense. This manuscript so nearly resembles the translation published in 1709, under the name of Lauderdale's Virgil, that I am persuaded it is the original of which a copy was sent to Mr. Dryden, and from which he was accused, by that nobleman's friends, of having borrowed not only single verses, but entire passages. By collating this manuscript with Mr. Dryden's version, it is satisfactorily proved that several verses were so borrowed, with but little alteration; as thus: Æneid III. 114. "Ergo agite," &c.

> "Let us the land, which fate directs, explore;
> Appease the winds, and seek the Cretan shore.
> Our way is short; if Jove assists our fleet,
> The third day's dawning lands us safe in Crete."
>
> MANUSCRIPT.

> "Let us the land, which heav'n appoints, explore;
> Appease the winds, and seek the Gnossian shore.
> If Jove assists the passage of our fleet,
> The third propitious dawn discovers Crete."
>
> DRYDEN.

"Nor are these alterations always in accordance with the true meaning of the Roman poet. Thus, the lines which are correctly rendered in the manuscript,

> "————In humble vales they dwelt.
> Thence Cybele, the mother of the gods,
> Her tingling cymbals and Idæan woods,"

are thus altered by Mr. Dryden:—

> "In humble vales they built their soft abodes,
> Till Cybele, the mother of the gods,
> With tingling cymbals charm'd th' Idæan woods."
>
> ÆN. III. 110.

"Mr. Stafford's version of the death of Camilla is the same as that published under his name in the poetical mis-

cellany, and from it Mr. Dryden has taken six or seven verses; while the greater part of it has been transferred, without acknowledgment, into Lauderdale's Virgil.

" The Episode of Nisus and Euryalus is peculiarly interesting, being from Mr. Dryden's pen, and varying frequently from the published translation. It contains some hemistich verses, which the poet, at a later period, condemned; comparing them to " frogs and serpents in the Nile, half in life, half mud."

" I regret that the limits of my paper do not admit of any extracts from this Episode."

DONATIONS.

The Silurian System. By R. J. Murchison. In two Parts. Presented by the Author.

Memoirs of the Royal Astronomical Society. Vol. X. Presented by the Society.

An Elementary Treatise on the Tides. By J. W. Lubbock, Esq. Presented by the Author.

An Inquiry into the Nature of the Numerical Contractions; and Notes on Early Calendars. By J. O. Halliwell, Esq. Presented by the Author.

Transactions of the Cambridge Philosophical Society. Vol. VI. Part III. Presented by the Society.

Transactions of the Royal Society of London. Parts I. and II. 1838. Presented by the Society.

Journal of the Franklin Institute, 1838. Presented by the Institute.

Collectanea de Rebus Albanicis, edited by the Iona Club. Presented by the Club.

Nouveaux Mémoires de l'Académie Royale de Bruxelles. Années 1837—1838. Tome XI.

Mémoires Couronnes par l'Académie Royale de Bruxelles. Tome XIV. Premiere Partie, 1838.

Bulletin de l'Académie de Bruxelles. Nos. 9—12.

Annuaire de l'Académie de Bruxelles. Cinquieme année. Presented by the Academy.

Annuaire de l'Observation de Bruxelles, pour 1839. Par M. Quetelet.

Resume des Observations Meteorologiques, 1838. Par M. Quetelet. Presented by the Author.

Comptes Rendus Hebdomadaires des Seances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. Nos. 12—17. Premier Semestrie, 1839. Presented by the Academy.

Eclaircissements sur la destination de trois Zodiaques Antiques. Par M. de Briere. Presented by the Author.

The Turkish Empire illustrated. Parts 1—12. Presented by Dr. Walsh.

Transactions of the Institution of Civil Engineers. Vol. III. Part I. Presented by the Institution.

May 27, 1839.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The thanks of the Academy were voted to Sir William Betham for his services as Secretary of Foreign Correspondence; he having resigned that office, together with his place in the Council.

Dr. Aquilla Smith was elected to the vacant place in the Council; and Professor Mac Cullagh was appointed Secretary of Foreign Correspondence.

Dr. Wilde made a second communication on the subject of the Peruvian Mummy. It appeared that, in accordance with the wish of the subscribers, a further examination of

the mummy had taken place; and the different articles that had been removed from it and cleaned, were exhibited, as well as the mummy itself, to the meeting. The pottery-ware vessels, which were placed underneath the chin, and which were supposed to have been used for making the infusion of the yerba de Paraguay, or mattee tea, at present a custom in that country, are of great beauty in colour, form, and ornament. One of them had the mark of fire on its outer side; the other, some crystals of salt round its aperture. Two bags of plain woollen cloth, and sewn up the sides, were found to contain a quantity of finely ground meal of a brown colour, still possessing some flavour, and having a saltish taste; and in one of the bags were also discovered two heads of small Indian corn, in great preservation. Two other bags of great beauty of texture, and brilliancy of colour, woven in stripes of blue and red, contained a quantity of dried leaves supposed to be the cocco, and a small quantity of clay-like burned substance. Both these bags are of exquisite workmanship, and bespeak a great perfection of the arts among this people; one was adorned with a handsome tassel work not unlike a lady's reticule: both were tied at top with a slip knot. All those substances were no doubt placed to afford a supply of food for the journey of the deceased to the land of spirits. The piece of cloth which surrounded all those, and which was fastened round the neck, was also exhibited, and appeared to be the remains of some old article of dress belonging to the deceased, from its similarity to the kilt and apron which surrounded the lower part of the body. These latter consisted of a broad piece of woollen cloth of different colours, tied round the loins; and the apron, which was of different colours, was fastened on the front of the body by strings which went over the shoulders. During the examination, a small curious beetle was discovered by Mr. Ball, on which Mr. Curtis, of London, writes, "undoubtedly it is a true *Ptinus* of Linnæus, although it seems

to be related to *mexium sulcatum*, figured in the 232nd plate of my British Insects." Mr. Curtis states, that *Ptini* breed in such situations; and the insect being a perfectly new species, for which he proposes the name of *ptinus mortuorum*, he thinks it worthy of being described, and offers his services for that purpose. The mouth of the mummy was next examined: the lower lip appears to have been split, probably after the manner of the natives of Nookta Sound, spoken of by Captain Cook. The teeth are now exposed to view; those of the lower and upper jaw are separated by some substance placed between. The hair, which has been cleaned and placed in its proper position, exhibits a beautiful mode of head adornment; two large plaits formed of a number of smaller ones, and tied at the end, hang down by the side of the face towards either shoulder: it is long, black, and slightly sprinkled with grey in front. The hair at back is likewise plaited, having seven plaits on one side, and eight on the other. The whole is collected in a tie behind, one lock forming the centre. In the bend of the arm was found the weight or plummet of a fishing line, (probably that which was twisted round the fingers of the left hand,) formed of some metallic substance as yet undecided on. In the British Museum there is a Peruvian mummy, an enlarged drawing of which Dr. Wilde exhibited from the work of Dr. Pettigrew; in this the hands are extended along the sides of the face, but the rest of the body is in the position of the one before the meeting, than which it is much less perfect, and the head is completely devoid of hair.

Dr. Wilde then read several extracts bearing upon the subject of Peruvian mummies, and mentioned the name of Mr. J. R. Pentland, who, in a communication made to Tiedemann, and translated by Professor Graves, in the Dublin Journal for July, 1834, gives an account of the ancient graves called *Huxeas*, in the Valley of Titicaca; these sepulchres have the form of high *round towers*, and in some places are con-

structed of enormous masses of masonry, the stones arranged in a manner similar to the Cyclopean architecture of Greece and Italy. In all the sepulchres which have been yet discovered, there are remains of food, cooking utensils, and different articles emblematical of their calling, which was generally that of fishermen. There is no artificial process of embalming used, nor were any of the cavities of the body opened, so that all the interior of this mummy is in a perfect state. The nature of the earth, and the peculiar dryness of both it and the atmosphere, are such as to prevent the putrefactive process; and animals thrown loosely in the earth are likewise preserved.

The question of the race of mankind to which this mummy belonged is one of great interest. From the pyramidal form of the head, and other circumstances, Dr. Wilde conceived it should be classed among the great Turanian nations, characterized by great breadth of cheek bones, lozenge-shaped faces, formed by the bases of two triangles meeting on the cheekbones, long straight hair, thin scanty beard, olive complexion, confluent features, depth of orbits, eyes wide apart, and more or less retreating foreheads; peculiarities, several of which he noticed as exhibited in the head of the mummy, which he did not think had been altered by artificial pressure, like the head of the modern Peruvian. Humboldt, Tiedemann, Dr. Pritchard, and Mr. Pentland, agree in giving this race an Asiatic origin; the last gentleman believing that the heads were not altered by pressure, and that the skulls of those ancient Peruvians belonged to a race of mankind now extinct.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1839. No. 18.

June 10.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

The following gentlemen were admitted Members of the Academy: William R. Wilde, Esq., Alexander Parker, Esq., and Jonathan Osborne, M. D.

RESOLVED,—That the Academy do allow a ballot to take place at the next Meeting, for W. Longfield, Esq., his name having been duly proposed within one month before that night, but too late for the ballot of this evening.

Sir Henry Marsh read a paper "on Phosphorescence or luminous Appearances;" the term phosphorescence being employed, without implying that the presence of phosphorus is necessary to the production of these phenomena.

The chief object of this communication was to bring forward some interesting facts relative to the evolution of light, in the living human subject; facts of this nature not having heretofore been publicly noticed. Indeed so little has this subject been scientifically investigated, that all such appearances have been referred to supernatural agency, the ultimate and easy refuge of ignorance and superstition.

To render the discussion more complete and intelligible, Sir H. Marsh introduced the general subject of luminous

appearances, as they are observed in the different kingdoms of nature.

Commencing with unorganized bodies, he particularized the sun and fixed stars, which are *always* luminous, but which derive this property from a source unknown and almost beyond conjecture. He then proceeded to the consideration of those bodies, placed under our more immediate cognizance, which are only *occasionally* luminous.

The aurora borealis is a beautiful instance of this property, clearly ascertained to be of electrical origin, by the fact that these lights, according to the observations of Arago and others, disturb the magnetic horizontal needle. That shooting stars spring from the same source is now universally conceded.

Some inorganic bodies are rendered luminous, under various circumstances; the diamond, arragonite, strontia, marble, calcareous spar, lime, and many other substances possess this property.

A species of fluor spar, found in the granite rocks of Siberia, shines in the dark with a remarkable phosphoric light, which increases when the temperature is raised: by immersion in boiling mercury it emits such a light that a book may be read by it at a distance of five inches.

Many bodies may be rendered luminous by friction, by percussion, or by concussion. Similar effects result from chemical action and reaction, as in the ordinary process of combustion. Many salts also, held in solution, exhibit luminous appearances at the time when crystallization is going forward. And by the agency of electricity many bodies can be rendered luminous, as proved by transmitting a series of electric discharges through fragments of chalk, sugar, quartz, succinic acid. After a few remarks on the important part which electricity plays in the production of all these effects, he went on to notice those luminous phenomena so remarkably exhibited in *organized* substances, at the moment of

incipient decomposition. Decaying wood, under peculiar conditions of temperature and humidity, evolves light; and it is well known that accumulated masses of vegetable matter, when not sufficiently dried, undergo fermentation, and, if the process be not interrupted, evolve light and caloric, and are destroyed by combustion. In recently dead *animal* matter the phenomena of phosphorescence is most strikingly exhibited. Soon after death, fishes become exceedingly luminous. In burial grounds luminous appearances have often been seen, and fearful and awful are they to the eye of superstition. These corpse-lights, as they are called, are clearly traceable to the same source, and take place during the earlier stages of disintegration. A very curious, though not very pleasing appearance of the same kind, and arising from the same causes, has been observed by many in dissecting rooms. The ignis fatuus also is a phenomenon, which, like those already alluded to, is produced by electricity, the result of chemical action in decaying vegetable matter, when the temperature is in neither extreme, and humidity sufficient to lend its aid in producing the effect.

Sir H. Marsh then proceeded to the consideration of phosphorescence, as a function in living vegetables, and described the extraordinary and brilliant appearance of phosphorescent lichens in the coal mines near Dresden. He also stated that the flowers of several plants, in serene and warm summer evenings, disengage light.

It is now known with certainty that light is developed in living animals, a large proportion of which are inhabitants of the sea, and from their presence in the water arises the phosphorescence of the waves, especially in the track of sailing vessels. The author here enumerated and described many of the most remarkable marine species of phosphorescent animals, and stated that luminous appearances had also been observed in fresh water animalcula.

He remarked the analogy betweeen luminous and electri-

cal fishes, and proposed the question, whether the vital property of emitting light was designed for the protection of these animals, or is it connected with the function of generation? The property of evolving light is not confined to aquatic animals; some of the terrestrial mollusca, as the limax noctilucus, produce a phosphorescent secretion capable of emitting a light of considerable brilliancy.

Many insects are luminous, as the several species of elater, the lampyris noctiluca and splendidula, the pausus sphœrocerus, scarabæus phosphoreus, and the scolopendra electrica.

The fulgora lanternaria is one of the most remarkable of the class, and during the night diffuses so strong a light, that a few, it is said, being fastened together, are employed to enlighten the path of the traveller, and to guide his foot steps during the darkness of night. Having made a few remarks on the tapetum lucidum existing in the eyes of some animals, the author proceeded to detail the chief object of his communication, namely, facts relative to the development of light in the living human subject. The first case that he narrated was that of a young lady in the last stage of pulmonary consumption. About ten days previously to her death, there was observed a very extraordinary light which seemed darting about the face, and illuminating all around her head, flashing like an aurora borealis: it was at night, and after a day of extreme nervous agitation produced by debility and the dread of suffocation. This luminous appearance commenced suddenly, and was at first mistaken, by her attendants, for the light of a candle, which was accordingly removed lest it should disturb the slumbers of the patient. The peculiar light, however, continued flitting over her countenance for more than an hour; its hue was not that of candle light, it was more silvery, like the reflection of moonlight on water. Three nights afterwards it re-appeared, and was observed by additional members of

her family, at a time when there was no candle in the room, no moon, nor in fact any visible means of producing light. The evening before the death of this young lady, the light was again seen, but it was less brilliant, and lasted only about twenty minutes.

Phenomena of the same kind were observed around the person of a man, who died of a lingering disease, in a remote part of the south west of Ireland : and a similar case is said to have been witnessed in Hull.

Sir H. Marsh then related the case of a woman, in the old Meath Hospital, who laboured under an enormous cancerous ulcer of the breast; from the surface and edges of the sore a quantity of fluid was constantly poured out, which became so luminous at night, as to be distinctly visible at a distance of more than twenty feet from her bed.

He suggested a comparison between the condition of a diseased part emitting light, and that state of the whole frame which characterizes the disease termed "spontaneous combustion;" and mentioned that in one case of spontaneous combustion, a lambent flame was distinctly seen to issue from the burning body. A strong analogy doubtless exists between this state of the living body, and the early state of decomposition, during which light is emitted.

He then detailed an experiment first performed by Magendie. Phosphorated oil was injected into the crural vein of a dog, when immediately its expirations became luminous, and continued so until the death of the animal.

The author concluded by remarking that the results of this experiment, and the ascertained presence of phosphorus in vegetables and animals, would lead to the opinion, that in some, at least, of the instances of luminous appearances referred to, phosphorus formed an element in the production of the effect.

W. O'Brien Esq. A.M., read a paper containing an Inquiry into the original Language of the Phœnicians.

He observes that the explanation given by Bochart and others of the Punic scene in Plautus, by means of the Hebrew, is much more natural than that derived from the Irish by Vallancey, who palmed some words upon that language which do not belong to it, and some from the modern Irish, which are English. He thinks that, even if the original language of the Phœnicians was not the Hebrew, they must generally have spoken that tongue at the time of the colonisation of Carthage, since the language of the multitude must always predominate over that of the few; and in the time of Solomon, the Israelites "could not be counted or numbered for multitude." Hence he infers that the ancient language must have been circumscribed within the very narrow limits of the few walled cities, and that the greater part of the adventurers after the first colonisation, must have spoken the Hebrew language only. Upon these grounds he concludes, that the Carthaginian language is no more an indication of the original language of the Phœnicians, than the English is of that of the ancient Britons or Irish. He considers, however, that we are not left without another clue to this language, besides that of the Carthaginians: since, although languages are obliterated, traces of them remain in the names of persons, places, rivers, mountains, &c. Thus, British names survive in England, in spite of the several conquests by Belgæ, Romans, Saxons, and Normans: and although these names are often much corrupted, a philologer of skill and discretion will be able frequently to see through the veil, and discover the original word. He shows that this view exactly corresponds to that taken by the celebrated Leibnitz, in his work on the origin of nations.

He then proceeds to investigate the roots and meaning of nearly forty of the names of places and tribes in Palestine. He professes to admit no derivation, which is barely conjec-

tural or plausible. One method of confirmation he uses, is, to trace the assigned roots through several languages and regions. Thus he traces one of them—*iodh-ar, ith-ar*—through vitrum,—κασσίτερος,—margarita—Eridanus—iohar, (borrowed he says by the Arabians from the Phœnicians)—Farsidh (Persia), and the names of some of the islands in the Persian Gulf. He traces *idh-on, iodh-on*, the roots of Sidon, through Chalcedon, Carchedon, Caledonia, and the Germanic aidstein, whereby he exhibits the meaning of those names also. He traces the roots of Solyma through the region inhabited by the Solymi of Homer, the Sulmo of Italy, and the Saluvii of Gaul, and shows from the accounts concerning those places, that the roots are equally applicable to them. The roots of the Hebrew borrowed word *glinnim* he traces through Germany, ancient Britain, Campania, and Liguria. Another mode of confirmation he uses is the quotation of, or reference to, various ancient and modern writers, in proof of the applicability of the terms.

He does not infer from this similarity of language, that the Irish are descended from a colony of Phœnicians, led—not from Tyre or Sidon, or any part of Syria, but—from the shores of the Red Sea, as Irish histories tell us; the greater part of which histories he imagines to be a tissue of fables, the rather, as they are at variance with the only authentic document relating to ancient Ireland, namely, the geography of Ptolemy. The conclusion he comes to is, that they had a common origin—that there was an ancient language diffused over almost the whole of Europe, and a good part of Asia; a sort of Pelasgic, which is the chief root of the Greek and Latin, and of most of the modern European languages; and that this ancient language is preserved in greater purity in Ireland than in any other country, on account of its insulated position. He shows that Leibnitz, a man of great sagacity and philological knowlege, made an observation not very dissimilar to this. "Illud autem notatu dignissimum, per

magnam continentis nostri partem, linguæ cujusdam antiquæ, latissime fusæ, vestigia in linguis hodiernis superesse; cum multa sint vocabula quæ inde ab Oceano Britannico ad usque Japonicum protenduntur.—Itaque lingua Hibernica refert nobis antiquiores Britannos, et adhuc antiquiores Germanos et Gallos. Proinde ex Hibernicâ antiquissimi Celtæ in lucem revocabuntur."—*De orig. Gentium.* Also, that a great modern philologer, Adelung, has arrived at similar results from collating the Parsee, Sanscrit, Greek, Latin, Sclavonian, and Germanic languages; viz., "That men of the same race peopled all these countries, previously to any historical record."

He holds, however, that colonies from Carthage did settle in Gaul and Britain, though not in Ireland ; that they spoke the Lybian language only, not the Hebrew ; and that this language is still in being, though much altered from its original, in the languages of Wales, Cornwall, and Bretagne.

It ought to be observed that he claims the settlement, incidentally, of some points of great interest to, and much contested by, antiquarians. 1. The meaning and application of the word Caledonia. 2. Of the Greek and Roman name for Carthage. 3. The roots and meaning of the Welch names, Menay and Meneu, words which baffled Lhuyd and Rowland. 4. The ancient names and uses of Cromlechs. He holds that their original purpose was that of hearths or bloomeries for the smelting of metals. That Hedar (of which he assigns the roots) in Danish Hothr, now Hoath, is the same word as *erath*, *arath*, hearth,—differing from it only in the transposition of the roots. That *chabar* is but a different dialect of the same word, whence the Cabiri, Guebres, derived their name and ceremonies. Also, that the hearth-stone was deified by the Germans, under the name of *hertha*, not terra mater, as Tacitus says, misinformed by persons who confounded the Germanic *erde* and *herde*, *erth* and *herth*.

DONATIONS.

Greenwich Observations, for 1836 *and* 1837, *with Appendix.* 4 Vols.

Greenwich Observations. 11 Numbers, from Part V. 1833, to Part V. 1835, inclusive.

Edinburgh Astronomical Observations, for 1834, 1835, *and* 1836. 2 Vols. Presented by the Royal Astronomical Society.

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Letters from Mecklenburgh and Holstein. 1 Vol. By George Downes, Esq. Presented by the Author.

Bulletin de la Société Géològique de France. Tome IX. Feuilles 23—32. 1837 à 1839. Presented by the Society.

Reply to Professor Bischof's Objections to the Chemical Theory of Volcanoes. By Charles Daubeny, M. D. Presented by the Author.

Comptes Rendus Hebdomadaires des Seances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. Nos. 18—21. Premier Semestre, 1839. Presented by the Academy.

June 24, 1839.

SIR WM. R. HAMILTON, A. M., President, in the Chair.

His Excellency the Lord Lieutenant was present at the meeting.

William Longfield, Esq., was elected a member of the Academy.

It was Resolved,—That the Treasurer be authorized to sell off stock of the Academy to the amount of £400, if so much be thought necessary by Council.

Professor Mac Cullagh presented and described to the Academy an ancient Irish Cross, which formerly belonged to the abbey of Cong, in the province of Connaught. It is a most interesting memorial of the period preceding the English invasion, and shows a very high state of art in the country at the time when it was made, which was the early part of the twelfth century, in the reign of Therdelach Ua Conchovar, (or Turlogh O'Conor,) father of Roderick, the last of the native kings of Ireland. This date is supplied by the Gaelic inscriptions, extremely clear and well cut, which cover the silver edges of the cross, and which, besides giving the names of the king and of contemporary dignitaries of the church, preserve that of the artist himself, who was an Irishman. A Latin inscription informs us that it contains a precious relic—a portion of the wood of the "true cross;" and this circumstance will account for the veneration in which it has been held for ages, though, unfortunately, it was not sufficient to protect it from injury, much of the ornamental work having been removed, and part of the inscriptions torn away. Notwithstanding these depredations, however, it is still a splendid monument of ecclesiastical antiquity.

In the centre of the arms, at their junction with the shaft, there is fixed a cruciform piece of oak, marked with the figure of a cross, and much older, apparently, than the rest of the wood, which is oak also. This piece bears marks of the knife, as if it had been taken for the relic; though it is perhaps too large to be so, and, besides, it does not appear that the true cross was made of oak. Hereabouts, however, the relic certainly was; for the place is surmounted by a very conspicuous crystal of quartz—a mode

of exhibiting such things that seems to be alluded to by Chaucer in the Canterbury Tales, where he makes his "Pardoner" say—

> "Then show I forth my longé *crystal stones*,
> Ycramméd full of cloutés and of bones;
> *Relics* they be, as weenen they each one."

The "crystal stone," indeed, in this instance, is not long, but round, being in fact a very thick double-convex lens, with one surface much more convex than the other; but in other cases, as on the *cumdachs* containing the book of St. Moling and the book of Dimma, the crystals are oblong, as described by the poet; and it is supposed that relics are always to be found beneath them.

The shape of the crystal is somewhat remarkable. Thin lenses, such as we have now, were not invented in those days, nor for a long time after; and the present specimen of a thick one, which could be of no use in viewing an object, unless placed in immediate contact with it, is to be classed among the lenticular gems of quartz, or rock crystal, which Dr. Priestly tells us are sometimes to be met with in the cabinets of the curious, and which, he says, are supposed to have belonged to the Druids.

The cross, like that of the "gentle Pardoner" aforesaid, is studded "full of stones," or rather imitations of them, disposed at regular distances along the edges, and elsewhere. The central crystal is surrounded by an elegant ornament in gold; and all the rest of the cross, both before and behind, is richly adorned with an interwoven tracery, of that peculiar kind which the Irish were so fond of. The tracery is of solid gold; the inscribed edging is of silver; and both are separated from the wooden frame by plates of copper; the whole being held together by nails, of which the heads are little heads of animals. The shaft also terminates below, in the double head of an animal, which is large, and very finely

executed. The end is hollow, to admit a staff, by which the cross was carried, like the crosier of an archbishop. The height of the shaft is about two feet and a half, and the span of the arms about nineteen inches.

Having made the foregoing observations, suggested by an actual inspection of the cross, Professor Mac Cullagh said that he would leave it to Mr. Petrie to give a more minute description of it, as well as to relate its history, how it was made at Clonmacnoise, and thence migrated to Cong, with many curious particulars which he had discovered respecting it by a comparison of existing documents. Mr. Petrie had been requested by the Academy to draw up a paper on the subject, (see p. 212) ; and it was to be hoped that he would soon comply with their desire.

In presenting the cross to the Academy, Professor Mac Cullagh stated, that his motive for doing so was, by putting it in the possession of a public body, to save it from that shameful process of destruction to which every thing venerable in Ireland has been exposed for centuries, and to contribute, at the same time, to the formation of a national collection, the want of which, he had been told, was regarded by Sir Walter Scott as a disgrace to a country so abounding in valuable remains. He trusted the time was not far distant when that reproach would be no longer merited; when the relics of antiquity, now scattered over the kingdom, would find their way to a place where they could be appreciated, studied, and preserved. He believed, indeed, that there already existed in the public mind a strong disposition in favour of such a plan; a disposition that only required to be awakened into action. For, no sooner had his intention with respect to the cross become known to a few friends, than a subscription was set on foot, to procure, for a similar purpose, the two magnificent *torques* found thirty years ago at Tara. These had travelled to England and back again, and they narrowly escaped being sent out of the country a

second time, and for ever. The timely subscription was immediately successful. The torques had been secured for the Academy; they were to be presented in the course of the same evening; and, along with the cross of Cong, they would help to form the nucleus of the future National Museum. With such a beginning, it was not too much to expect a rapid progress; since matters so attractive and important in themselves would naturally tend to draw others around them.

The special thanks of the Academy were voted to Professor Mac Cullagh for his present of the Cross.

Mr. Mallet gave a notice of the present state of the investigation, entrusted by the British Association to Professor Davy and himself, upon the action of air and water, whether fresh or salt, and under various modifications, upon cast and wrought iron. From the press of other papers, Mr. Mallet was obliged to confine himself to a very brief notice respecting a new mode of protection which he proposed for iron, when exposed to air and water.

This method is of the electro-chemical class, and is founded on the fact, that the softer and more carbonaceous cast irons, such as the Scotch and Irish, are in a positive condition with respect to the less carbonaceous irons, such as the Welch, &c., in common use for engineering purposes.

This difference of electrical condition he has found experimentally to be sufficient to enable protectors of the former sort of iron to be applied to the surface of the latter, with the result of largely preventing the corrosion of the electro-negative metal. This was shown by the exhibition of the results of experiments which had been several months in progress.

It was also stated, that while tin increases the corrosion of iron, contrary to the opinion of Sir Humphry Davy, zinc does not seem to possess a protective power wholly permanent, at least in salt water, from the formation on its

surface, after a lapse of three years or more, of insoluble crystals of carbonate lime, having the form and hardness of calc spar, which prevent chemical action on the metal.

The Rev. H. Lloyd, V. P., read a paper descriptive of the Magnetical Observatory of Dublin, and of the instruments and modes of observation employed there. After some prefatory remarks on the anomalous movements of the magnetic declination, and on the establishment of magnetical stations which took its rise from their study, the author proceeded to the immediate subject of his communication.

The Magnetical Observatory of Dublin was erected by order of the Board of Trinity College, the funds being supplied from the College chest. The building was commenced in the summer of the year 1837, and was completed in the course of the following year. The structure, which is of the Doric order, is situated in an open space in the gardens attached to the College: its dimensions are forty feet in length, by thirty in depth. It is constructed of Portland stone, the interior stone of the building being the argillaceous limestone (*calpe*) of the valley of Dublin; several specimens of each of these stones had been previously submitted to a rigid examination, and found to be entirely devoid of any effect upon the magnetic needle. The interior walls of the building are studded, for the purpose of maintaining a uniform temperature, as well as to protect from damp. The nails employed in the woodwork are of copper, and the other metallic fastenings (locks, hinges, &c.,) of brass; no iron whatever being used in any part of the building.

The interior is divided into one principal room and two smaller rooms; one of the latter serving as a closet, and the other as a vestibule. The principal room is thirty-six feet in length, by sixteen in breadth; and has projections in its longer sides, which increase the breadth of the central part to twenty feet. This room is lighted by a dome light at top,

and by a window at each end. It contains six stone pillars for the support of the instruments: these are imbedded in solid masonry beneath the floor, and the supports of the floor are framed around them, so that they are completely insulated.

The elements on which the determination of the earth's magnetic force is usually based are, the *declination*, the *inclination*, and the *intensity*. If a vertical plane be conceived to pass through the direction of the force, that direction will be determined when its inclination to the horizon is given, as well as the angle which the plane itself forms with the meridian; and if, in addition to these quantities, we likewise know the number which expresses the ratio of the intensity of the force to some established unit, it is manifest that the force is completely determined.

For many purposes, however, and especially in the delicate researches connected with the *variations* of the magnetic force, a different system of elements is preferable. If the intensity be resolved into two portions in the plane of the magnetic meridian, one of them *horizontal* and the other *vertical*, it is manifest that these two components may be substituted for the total intensity and the inclination; while, at the same time, their changes may be determined with far greater precision. The former variables are connected with the latter by the relations

$$\mathrm{X} = \mathrm{R} \cos u, \quad \mathrm{Y} = \mathrm{R} \sin u;$$

in which R denotes the intensity, X and Y its horizontal and vertical components, and u the inclination. It will be easily seen that the *variations* of u and R are expressed in terms of the variations of X and Y by the following formulæ:

$$\delta u = \sin u \cos u \left(\frac{\delta \mathrm{Y}}{\mathrm{Y}} - \frac{\delta \mathrm{X}}{\mathrm{X}}\right);$$

$$\frac{\delta \mathrm{R}}{\mathrm{R}} = \cos^2 u \frac{\delta \mathrm{X}}{\mathrm{X}} + \sin^2 u \frac{\delta \mathrm{Y}}{\mathrm{Y}}.$$

Mr. Lloyd then proceeded to describe the instruments

employed in the determination of these elements and their changes.

The magnet of the *declination instrument* is a rectangular bar, fifteen inches long, suspended by parallel silk fibres, and enclosed in a box to protect it from the agitation of the air. In addition to the stirrup, by which the bar is suspended, it is likewise furnished with two sliding pieces, one near each end of the bar. One of these pieces contains an achromatic lens, and the other a finely divided scale of glass; the scale being adjusted to the focus of the lens, it is nanifest that the apparatus constitutes a moving collimator, and that its absolute position at any instant, as well as its changes of position from one instant to another, may be read off by a telescope at a distance. The stirrup is so contrived as to enable the observer to invert the bar, and thus, by the mean of the two readings, to determine the point of the scale corresponding to its magnetic axis.

The framework of the instrument consists of two pillars of copper, thirty-five inches in height, firmly screwed to a massive slab of marble. These pillars are connected by two cross pieces of wood—one at the top, and the other seven inches from the bottom. In the centre of the top piece is the suspension apparatus, and a divided circle used in determining the amount of torsion of the thread. A glass tube, between this and the middle of the lower cross-piece, encloses the suspension thread; and a glass cap at top covers the suspension apparatus, and completes the enclosure of the instrument.

The box is cylindrical, and has two apertures opposite to each other. The aperture in front, used for reading, is covered by a circular piece of parallel glass, attached to a rectangular frame of wood which moves in dovetails; the prismatic error of the glass (if any) is corrected by simply reversing the slider in the dovetails. The opposite aperture is used for the purpose of illuminating the scale.

The apparatus is likewise provided with a brass bar (also furnished with a collimator) for the purpose of determining the plane of detorsion of the suspension thread;—a thermometer, the bulb of which enters the box, in order to determine the interior temperature;—and a copper ring, used in checking the vibrations.

The instrument used in determining the *horizontal component* of the magnetic force is a magnet bar suspended by two parallel wires, and maintained, by the torsion of their upper extremities, in a position at right angles to the magnetic meridian. The directive force due to the mode of suspension is known, when we know the weight of the suspended body, the interval of the wires, and their length; and the ratio of this force to the horizontal component of the magnetic force is given, when we know the angle through which the upper extremities of the wires have been turned, in bringing the suspended bar into the perpendicular position. The magnet being thus maintained in its position by the action of two forces, one of which (the torsion force) is constant, while the other (the magnetic force) is variable, it is manifest that its place will vary around its mean position; and that these variations of angle are connected with the variations of the force, so that when the former are given, the latter are known. The variations of the angle are read off, as in the other instrument, by a collimator and divided scale; and the delicacy of the instrument is such, that (with the adjustment of the parts at present in use in the Observatory) we may estimate changes in the horizontal force amounting to $\frac{1}{30000}$th part of the whole.

The larger parts of this apparatus,—the box, the framework, and the support,—are precisely similar to those of the declination instrument. There are, however, several differences in the essential parts of the instrument, arising chiefly from the different nature of the suspension. The collimator is attached to the stirrup, and has a motion in

azimuth, an arrangement which is necessary in the adjustments. The suspending wire passes round a small grooved wheel, on the axis of which the stirrup rests by inverted Ys; and the instrument is furnished with a series of such wheels, of different diameters, for the purpose of varying the interval of the wires. This interval is altered, at the upper extremity, by means of two screws (one right handed and the other left handed,) cut in the same cylinder; the wires being lodged in the intervals of the threads, and their distance regulated by means of a micrometer head.

The third instrument is that used in determining the changes in the *vertical component* of the magnetic force. It is a magnet resting on agate planes, by knife edges, and brought to the horizontal position by weights. There is a small cross of wires near each end, and the changes of position of the magnet are read off by a pair of microscopes. From these changes of position, the changes of the vertical force are inferred, when we know the *inclination* at the place of observation, the *azimuth* of the plane in which the needle moves, and the angle which the line connecting the centre of gravity and centre of motion makes with the magnetic axis of the needle. As the determination of this latter constant would require that considerable additions should be made to the apparatus, Mr. Lloyd has preferred to *adjust* the weights so that the angle in question shall be *nothing*. The weights are small brass screws moving in fixed nuts, one on each arm; the axis of one of these screws is *perpendicular* to the magnetic axis of the bar, and its movement consequently produces the desired adjustment: the other screw (the heavier) is *parallel* to the magnetic axis, and serves to adjust the magnet to the horizontal position. Each of these adjustments admits of an easy test.

The supports of the magnet, and of the micrometers, are firmly attached to a massive slab of marble, which is cemented to the stone pillar on which it is placed; and a spirit-

level, attached to the base, serves to indicate any change which may occur in the level of the instrument. The magnet is of course covered with a box, to protect it from the agitation of the air; and the apparatus is furnished with several minor pieces, which are employed in the various adjustments.

In addition to these instruments, which are those in constant use, the Observatory is furnished with an inclination instrument and a pair of needles, made by Gambey; a transit instrument and large theodolite, used chiefly in determining the *absolute* declination; a transit clock and a chronometer; and a complete set of meteorological instruments.

Mr. Lloyd closed his communication with a brief account of the important undertaking in which her Majesty's Government had recently engaged, for the purpose of advancing the knowledge of Terrestrial Magnetism—an undertaking which he characterized as the vastest in its design, as it might also be expected to be the most fruitful in its results, of any which the British, or any other government, had ever engaged in, in behalf of science.

The Secretary read the following communications from George James Knox, Esq., giving an account of his further researches on Fluorine:

1. *On the Insulation of Fluorine.*

"In a paper on the Insulation of Fluorine which the Rev. Thomas Knox and I had the honor of presenting to the Royal Irish Academy in the year 1837, and which was afterwards published in their Transactions, (vol. xviii. p. 127,) we proved that we had obtained fluorine in an insulated state, by shewing its action upon bismuth, palladium, and gold; but being unable, from our mode of experimenting, to determine what the nature of fluorine at ordinary temperatures might be, i. e. whether it be a solid, a liquid, or a gas, we suggested that such information might be obtained from the

electrolization of a fluoride, using as the positive electrode some substance with which this energetic principle should not enter into chemical combination.

"Finding that, since the publication of our paper, no person had entered upon this field of investigation, I considered that the ultimate solution of this problem devolved as a point of duty upon myself; under which impression I undertook the following experiments.

"A fluorspar stopper was made to fit the mouth of one of the fluorspar vessels described in our former paper; that part of the stopper within the vessel being made of the form of a semi-cone, the vertex of which reached nearly to the bottom of the vessel. Through the stopper were drilled vertically three small holes, one through its entire length, the other two through one-third of its length. In the first was inserted a platinum wire, to be used as the negative electrode; in one of the two small holes was inserted a thin platinum wire, bound round a piece of charcoal, intended to form the positive electrode; in the other hole I put gold leaf, litmus, or any other substance upon which I wished to try the action of the gas. Matters being so arranged, the fluorspar vessel was about half filled with anhydrous hydrofluoric acid, the chemical purity of which had been previously ascertained. The platinum wire forming the negative electrode was raised a little above the bottom of the stopper, in order to allow the bubbles of hydrogen to rise through the perforation in the stopper, in place of mixing with the fluorine in the vessel; the wires were then placed in contact with the poles of a constant battery of sixty pair of plates, and the action was allowed to continue for the space of two hours; at the end of which time the litmus was found to be reddened, and the gold not acted upon, but a large quantity of subfluoride of iron formed.

"In the next experiment I made use of a piece of charcoal, from which the iron had been removed by boiling it in

nitric acid; in this experiment there was no subfluoride of iron formed, but the vessel was found to contain fluosilicic acid gas.

"In a third experiment a piece of charcoal was employed, which had been previously freed from all metallic impurities and from silica, by being first boiled in pure nitric acid, and afterwards in hydrofluoric acid. Employing this purified charcoal as the positive electrode, I obtained no *immediate* action upon the litmus paper; but after the action had continued for two hours, it was found to be completely bleached, while the gold had undergone no sensible action. That the bleaching was not due to the action of the vapour of hydrofluoric acid was ascertained, by leaving litmus paper for several hours in the neck of a platinum retort, from which hydrofluoric acid was distilling.

"The battery was now kept in action for fifteen hours, at the end of which time the vessel being examined, the litmus had disappeared, and the gold leaf showed signs of having been strongly acted upon, having assumed a dark brownish colour, and having gathered itself into little balls, as if it had undergone the action of heat. The platinum wire was acted upon in those parts where it was in contact with the charcoal, but no where else.

"When the platinum wire forming the positive electrode passed through the stopper to the bottom of the vessel, the hydrogen, in place of rising through the perforation in the stopper, as in the former instance, rose now into the receiver, where, upon applying a light, it exploded, showing that it does not enter into combination with fluorine without the aid of heat. The presence of the vapour of hydrofluoric acid in the vessel prevented me from determining by other experiments how far fluorine was a supporter of combustion.

"To determine the colour of the gas, a stopper of fluorspar similar to the former was made to fit one of the transparent fluorspar receivers formerly described. The gas evolved in the receiver appeared colourless.

"As the action of the gas upon glass could not be determined, owing to the presence of the vapour of hydrofluoric acid, I fused in a bent tube of German glass (such as is used in organic analysis) fluoride of lead. The wire holding the charcoal was made to pass through a cork inserted in one end of the tube, the other platinum wire merely dipped into the fused fluoride. On connecting the wires with the battery, strong electrolytic action commenced, bubbles of gas were evolved rapidly at the surface of the charcoal, which, on arriving at the surface of the fused fluoride of lead, acted instantly upon the glass. The litmus paper was not bleached, nor the gold leaf or platinum wire acted upon. Whether fluorine would act upon perfectly dry cold glass remains to be proved.

"*Conclusion.*—Fluorine then, when obtained in an insulated state, is a colourless gas, possessing properties analogous in all respects to those of chlorine; having, like it, strong attractive powers for hydrogen and metals, but inferior to it in negative electrical energy."

2. Note on a Compound of Fluorine with Selenium.

"When the vapour of selenium is passed over fluoride of lead fused in the platinum apparatus employed in obtaining the fluorides of carbon and cyanogen, a seleniuret of lead is formed, and crystals similar in form to those of fluoride of carbon are condensed in the cold receiver. These crystals are soluble in strong hydrofluoric acid. They sublime unaltered at a high temperature. They are instantly decomposed by water or acids, in which property they resemble the fluorides of sulphur and phosphorus."

The President read a paper, by the Rev. Dr. Robinson, M.R.I.A., &c., on the recent Employment of Rockets to determine the Difference of Longitudes of Armagh and Dublin, and on the proposed Extension of this Operation to other British Observatories.

In this paper, after alluding to the recommendation of the

British Association at Edinburgh, and reviewing the history of the principal operations of the kind which have been hitherto performed, the author remarks that the Observatory of Armagh is unfavorably situated for comparison by signals with that of Dublin, though the distance is but sixty-eight miles; there being ground about four miles to the south of Armagh from 700 to 1200 feet of height; and a ridge from 600 to 400 feet high, about fourteen miles north of Dublin. Lieutenant Larcom investigated all possible stations, giving for each its distance and azimuth, and the height above its summit to which the signal should be elevated to make it visible from both observatories. His help was of essential importance; and in consequence of the data supplied by him, the station Slieve Gullion was adopted; which is 1893 feet high, and is distant eighteen miles from Armagh and fifty-one from Dublin. At the latter its summit is a few seconds above the boundary of view, but, at the former, so much below that boundary, that a height of 800 feet above the summit would be required to clear it. Rockets were therefore necessary, and on applying for them to the Honourable Board of Ordnance, they were supplied from Woolwich with the utmost liberality.

In the operations alluded to above, the rockets (supplied by the French Goverment) were what is called 2lbs. and carried 8 oz. of powder; a very great number of them did not rise to a sufficient height; and Dr. Robinson thought it unsafe to use any of less dimensions.

The Ordnance also provided tents for the firing party and an escort of police was granted by Lieut.-Colonel M'Gregor for their protection, which however proved quite unnecessary.

On the 13th of May they were dispatched to the mountain, under the orders of Dr. Robinson's eldest son, and established there in a few hours by the kind aid of the Rev. Dr. Campbell, Rector of Forkhill, which removed every difficulty; and

though it was very tempestuous, there were fired fourteen rockets on the 14th, thirteen on the 15th, twenty on the 20th, twenty on the 21st, and nine on the 23rd, in all seventy-six. Of these, sixty-three were observed at Armagh, and fifty-three at Dublin, but only forty-two were simultaneous. The explosions were visible to the naked eye at Armagh, and to an ordinary nightglass at Dublin; they were however observed, at the latter, by Sir William Hamilton and Mr. Thompson, his assistant, with the equatorial of five inches aperture, and the dome clock; at the former by Dr. Robinson with the finder of his great equatorial (two inches three-fourths aperture) and its clock, and by Mr. Edmonson, his assistant, with a telescope (3,2 inches aperture) and the transit clock. A third observer also (but one not much practised) observed them with the west equatorial.

The time at each observatory was determined by a list of stars previously selected and reduced by the places of Encke's Jahrbuch, so that it is conceived there can be no uncertainty in the work except what arises from the personal equations of the observers, which Dr. Robinson hopes to determine on his way to Birmingham. The numbers of the stars used on each night are stated, and also the probable errors of transit and rocket observations; and the probable mean of the whole work is inferred to give for the difference of longitudes of the two observatories, $1^{m}\,14^{s}$, 425, exceeding the result of Mr. Dent's chronometers by 0^{s}, 035.

The prosecution of these observations was interrupted by the full moon, but the certainty of their result appears sufficient without resuming them. As however there is a mountain in Leitrim where the rockets will be visible at once from Armagh, Dublin, and Mr. Cooper's Observatory of Markree, in Sligo, the determination of the latter apppears sufficiently important to make Dr. Robinson select that station in case of pursuing the matter any further. But it is even more important to cross the Channel. These 2lb.

rockets rose 800 yards; if fired at Plinlimmon, they will be visible at Dublin, and probably even at Oxford; on the other hand, from Knocklaid, near Ballycastle, county Antrim, they could be seen at points on the west coast of Scotland, which see Ben Lomond, and can be joined by powder signals on it with Edinburgh. This however would require a transit instrument to be established, but the object to be effected is so important that Dr. Robinson hopes to accomplish it.

The President concluded his account of his First Series of Researches respecting Vibration, connected with the Theory of Light. The following is an outline of one of the investigations which are contained in the Series referred to.

It is proposed to integrate the system of equations in mixed differences,

$$\mathrm{D}_t^2 \delta x_{g,h} = \Sigma_{\Delta g} \delta \left(\mathrm{R} \, . \, \Delta_g x_{g,h}\right); \qquad (1)$$

in which h is any integer number from 1 to n inclusive; $x_{g,h}$ is independent of t, but $\delta x_{g,h}$ is a function of t and of $x_{g,1}, \ldots x_{g,n}$, the form of which function it is the object of the problem to discover;

$$\mathrm{R} = m_{g+\Delta g} \phi\left(\tfrac{1}{2} \Sigma_{(h)1}^{n} (\Delta_g x_{g,h})^2\right), \qquad (2)$$

ϕ being any real function of the semi-sum which follows it, and m being any other real function of the index $g + \Delta g$; while g and $g + \Delta g$ represent any integer numbers from negative to positive infinity. The equations to be integrated may also be thus written:

$$\xi''_{g,h,t} = \Sigma_{\Delta g}\left(\mathrm{R} \Delta_g \xi_{g,h,t} + \mathrm{R}' \Delta_g x_{g,h} \Sigma_{(h)1}^{n} \Delta_g x_{g,h} \Delta_g \xi_{g,h,t}\right), \qquad (1)'$$

in which

$$\mathrm{R}' = m_{g+\Delta g} \phi'\left(\tfrac{1}{2} \Sigma_{(h)1}^{n} (\Delta_g x_{g,h})^2\right); \qquad (2)'$$

the functions to be found by integration are now those of

the form $\xi_{g,h,t}$, considered as depending on t and on $x_{g,1}, \ldots x_{g,n}$; their initial values, and initial rates of increase (relatively to t), namely $\xi_{g,h,0}$ and $\xi'_{g,h,0}$, are regarded as arbitrary but given and real functions of $x_{g,1}, \ldots x_{g,n}$; it is also supposed, in order to simplify the question, that all the sums of the forms

$$\left.\begin{array}{c} \Sigma_{\Delta g}\, \mathrm{R}\left(\Delta_g x_{g,1}\right)^{a_1} \ldots \left(\Delta_g x_{g,n}\right)^{a_n},\ \Sigma_{\Delta g}\, \mathrm{R}'\left(\Delta_g x_{g,1}\right)^{a_1} \ldots \\ \left(\Delta_g x_{g,n}\right)^{a_n}, \end{array}\right\} \quad (3)$$

are independent of g, and are $= 0$ when any one of the exponents $a_1, \ldots a_n$ is an odd number. These equations are analogous to, and include, those which M. Cauchy has considered in his memoir on the Dispersion of Light, and may be integrated by a similar analysis.

A particular integral system may in the first place be found by assuming

$$\xi_{g,h,t} = \mathrm{X}_r\, \mathrm{A}_{h,r} \cos\left(\varepsilon_r + s_r t - \Sigma_{(i)1}^{\ n} u_i x_{g,i}\right); \qquad (4)$$

$$\Sigma_{(h)1}^{\ n} \mathrm{A}_{h,r}^2 = 1; \qquad (5)$$

$$s_r^2 \mathrm{A}_{h,r} = \Sigma_{(i)1}^{\ n} \mathrm{H}_{h,i}\, \mathrm{A}_{i,r}; \qquad (6)$$

$$\mathrm{H}_{h,h} = \Sigma_{\Delta g}\left(\mathrm{R} + \mathrm{R}'(\Delta_g x_{g,h})^2\right) \text{ vers } \left(\Sigma_{(i)1}^{\ n} u_i \Delta_g x_{g,i}\right), \qquad (7)$$

$$\mathrm{H}_{h,i} = \Sigma_{\Delta g}\, \mathrm{R}' \Delta_g x_{g,h} \Delta_g x_{g,i} \text{ vers } \left(\Sigma_{(i)1}^{\ n} u_i \Delta_g x_{g,i}\right); \qquad (7)'$$

the index r being any integer from 1 to n, and being introduced in order to distinguish among themselves the n different (and in general real) systems of values of s^2, and of the $n-1$ ratios of $\mathrm{A}_1, \ldots \mathrm{A}_h, \ldots \mathrm{A}_n$, which are obtained by resolving the system of the n equations of the form

$$s^2 A_h = \Sigma_{(i)1}^{n} H_{h,i} A_i, \qquad (6)'$$

in which, by (7)',

$$H_{i,h} = H_{h,i}. \qquad (7)''$$

It is important to observe, that by the form of these equations (6)', (which occur in many researches,) we have the relation

$$\Sigma_{(h)1}^{n} A_{h,q} A_{h,r} = 0, \qquad (5)'$$

if q be different from r; and that, by (5) and (5)', we have also the relations

$$\Sigma_{(r)1}^{n} A_{h,r}^2 = 1, \qquad (8)$$

$$\Sigma_{(r)1}^{n} A_{h,r} A_{i,r} = 0. \qquad (8)'$$

In the particular integral (4), we may consider $u_1, \ldots u_n$ as arbitrary parameters, of which X_r and ϵ_r are real and arbitrary, while s_r^2 and $A_{h,r}$ are real and determined functions; and hence, by summations relatively to the index r, and integrations relatively to the parameters u_i, employing also the relations (5) (5)' (8) (8)', and Fourier's theorem extended to several variables, we deduce this general integral, applying to all arbitrary real values of the initial data:

$$\xi_{g,h,t} = \left(\Pi_{(i)1}^{n} \int_{-\infty}^{\infty} du_i\right)\left(E_{h,t} \cos + F_{h,t} \sin\right) \Sigma_{(i)1}^{n} u_i x_{g,i}; \qquad (9)$$

in which

$$\Pi_{(i)1}^{n} \int_{-\infty}^{\infty} du_i = \int_{-\infty}^{\infty} du_1 \int_{-\infty}^{\infty} du_2 \ldots \int_{-\infty}^{\infty} du_n; \qquad (10)$$

$$\left.\begin{aligned} E_{h,t} &= \Sigma_{(r)1}^{n} A_{h,r} \left(Y_r \cos ts_r + Y'_r s_r^{-1} \sin ts_r\right), \\ F_{h,t} &= \Sigma_{(r)1}^{n} A_{h,r} \left(Z_r \cos ts_r + Z'_r s_r^{-1} \sin ts_r\right); \end{aligned}\right\} \qquad (11)$$

$$\left.\begin{array}{ll} \mathrm{Y}_r = \Sigma_{(h)1}^{\ n}\, \mathrm{A}_{h,r}\, \mathrm{E}_{h,0}, & \mathrm{Y}'_r = \Sigma_{(h)1}^{\ n}\, \mathrm{A}_{h,r}\, \mathrm{E}'_{h,0}, \\ \mathrm{Z}_r = \Sigma_{(h)1}^{\ n}\, \mathrm{A}_{h,r}\, \mathrm{F}_{h,0}, & \mathrm{Z}'_r = \Sigma_{(h)1}^{\ n}\, \mathrm{A}_{h,r}\, \mathrm{F}'_{h,0}; \end{array}\right\} \quad (12)$$

$$\left.\begin{array}{l} \mathrm{E}_{h,0} = \left(\frac{1}{2\pi}\right)^n \left(\Pi_{(i)1}^{\ n} \int_{-\infty}^{\infty} dx_{g,i}\right) \xi_{g,h,0} \cos\left(\Sigma_{(i)1}^{\ n}\, u_i x_{g,i}\right), \\ \mathrm{E}'_{h,0} = \left(\frac{1}{2\pi}\right)^n \left(\Pi_{(i)1}^{\ n} \int_{-\infty}^{\infty} dx_{g,i}\right) \xi'_{g,h,0} \cos\left(\Sigma_{(i)1}^{\ n}\, u_i x_{g,i}\right), \\ \mathrm{F}_{h,0} = \left(\frac{1}{2\pi}\right)^n \left(\Pi_{(i)1}^{\ n} \int_{-\infty}^{\infty} dx_{g,i}\right) \xi_{g,h,0} \sin\left(\Sigma_{(i)1}^{\ n}\, u_i x_{g,i}\right), \\ \mathrm{F}'_{h,0} = \left(\frac{1}{2\pi}\right)^n \left(\Pi_{(i)1}^{\ n} \int_{-\infty}^{\infty} dx_{g,i}\right) \xi'_{g,h,0} \sin\left(\Sigma_{(i)1}^{\ n}\, u_i x_{g,i}\right). \end{array}\right\} \quad (13)$$

This general solution involves multiple integrals, of the order $2n$; but many particular suppositions, respecting the initial data, conduct to simpler expressions, among which the following appear worthy of remark.

Suppose that having assumed some particular set $u^{\backprime}_1, \ldots u^{\backprime}_n$, of values of the n arbitrary quantities $u_1, \ldots u_n$, we deduce a corresponding set of coefficients $\mathrm{H}^{\backprime}_{h,h}$, $\mathrm{H}^{\backprime}_{h,i}$, by the formulæ (7) and (7)$'$, and represent by $s^{\backprime 2}_1$ and by $\mathrm{A}^{\backprime}_{1,1}, \ldots \mathrm{A}^{\backprime}_{h,1}, \ldots \mathrm{A}^{\backprime}_{n,1}$ some one corresponding system of quantities which satisfy the equations

$$\Sigma_{(h)1}^{\ n}\, \mathrm{A}^{\backprime 2}_{h,1} = 1, \qquad (5)^{\backprime}$$

$$s^{\backprime 2}_1\, \mathrm{A}^{\backprime}_{h,1} = \Sigma_{(i)1}^{\ n}\, \mathrm{H}^{\backprime}_{h,i}\, \mathrm{A}^{\backprime}_{i,1}; \qquad (6)^{\backprime}$$

we shall then have, as a particular integral system, that which is thus denoted:

$$\xi_{g,h,t} = \mathrm{X}^{\backprime}_1\, \mathrm{A}^{\backprime}_{h,1} \cos\left(\epsilon^{\backprime}_1 + s^{\backprime}_1 t - \Sigma_{(i)1}^{\ n}\, u^{\backprime}_i x_{g,i}\right); \qquad (4)^{\backprime}$$

$\mathrm{X}^{\backprime}_1$ and $\epsilon^{\backprime}_1$ denoting here any arbitrary real quantities. If

therefore we suppose that the initial data $\xi_{g,h,0}$ and $\xi'_{g,h,0}$ are all such as to agree with this particular solution, that is, if we have, for all values of g and h,

$$\xi_{g,h,0} = \text{X}`_1\, \text{A}`_{h,1} \cos\left(\epsilon`_1 - \Sigma_{(i)1}^{\;n} u`_i x_{g,i}\right), \qquad (14)$$

$$\xi'_{g,h,0} = -s`_1 \text{X}`_1 \text{A}`_{h,1} \sin\left(\epsilon`_1 - \Sigma_{(i)1}^{\;n} u`_i x_{g,i}\right), \qquad (14)'$$

we see, *à priori*, that the multiple integrations ought to admit of being all effected in finite terms, so as to reduce the general expression (9) to the particular form (4)`; an expectation which the calculation, accordingly, *à posteriori*, proves to be correct. An analogous but less simple reduction takes place, when we suppose that the initial equations (14) and (14)′ hold good, after their second members have been multiplied by a discontinuous factor such as

$$\tfrac{1}{2}\left(1 - \frac{2}{\pi}\int_0^\infty \frac{\sin\left(k\,\Sigma_{(i)1}^{\;n} u`_i x_{g,i}\right)}{k}\, dk\right), \qquad (15)$$

which is $= 1$, or $= \frac{1}{2}$, or $= 0$, according as the sum $\Sigma_{(i)1}^{\;n} u`_i x_{g,i}$ is < 0, or $= 0$, or > 0. It is found that, in this case, the $2n$ successive integrations (required for the general solution) can in part be completely effected, and in the remaining part be reduced to the calculation of a simple definite integral; in such a manner that the expression (9) now reduces itself rigorously to the following:

$$\left.\begin{aligned} \xi_{g,h,t} &= \tfrac{1}{2}\, \text{X}`_1\, \text{A}`_{h,1} \cos\left(\epsilon`_1 + t s`_1 - \Sigma_{(i)1}^{\;n} u`_i x_{g,i}\right) \\ &+ \frac{1}{\pi}\, \text{X}`_1 \int_0^\infty \frac{dk}{k^2 - k`^2}\left(\text{L}_t \cos \epsilon`_1 + \text{M}_t \sin \epsilon`_1\right); \end{aligned}\right\} \qquad (16)$$

in which

$$\left.\begin{aligned} \text{L}_t &= \text{P}_t\, k` \cos kx - \text{Q}_t\, k \sin kx, \\ \text{M}_t &= \text{P}_t\, k \sin kx + \text{Q}_t\, k` \cos kx, \end{aligned}\right\} \qquad (17)$$

$$\left.\begin{aligned} \mathrm{P}_t &= s'_1\, \Sigma_{(r)1}^{\ n} \left(\mathrm{A}_{h,r}\, s_r^{-1} \sin ts_r \,.\, \Sigma_{(h)1}^{\ n} \mathrm{A}_{h,r}\, \mathrm{A}'_{h,1}\right), \\ \mathrm{Q}_t &= \Sigma_{(r)1}^{\ n} \left(\mathrm{A}_{h,r} \cos ts_r \,.\, \Sigma_{(h)1}^{\ n} \mathrm{A}_{h,r}\, \mathrm{A}'_{h,1}\right), \end{aligned}\right\} \quad (18)$$

$$x = \Sigma_{(i)1}^{\ n} a'_i\, x_{g,i}, \quad (19)$$

$$ka'_i = u_i, \; k'a'_i = u'_i, \qquad k'^2 = \Sigma_{(i)1}^{\ n} u'^2_i, \quad (20)$$

and s_r, $\mathrm{A}_{h,r}$ are the same functions as before of $u_1, \ldots u_n$.

A remarkable conclusion may now be drawn from these expressions, by supposing that all the quantities of the form s_r^2 are not only real but positive, so that the functions $\cos ts_r$ and $\sin ts_r$ are periodic. For in this case the functions $\cos(ts_r \pm kx)$ and $\sin(ts_r \pm kx)$ will vary rapidly, and pass often through all their fluctuations of value, between the limits 1 and -1, while k and the other functions of that variable remain almost unchanged, provided that $t\,\dfrac{ds_r}{dk} \pm x$ is large, and that the denominator $k^2 - k'^2$ is not extremely small. We may therefore in general confine ourselves to the consideration of small values of this denominator; and consequently may put it under the form $2k'(k - k')$, making $k = k'$ in the numerator, except under the periodical signs, and integrating relatively to k between any two limits which include k', for example between $-\infty$ and $+\infty$. And because

$$\Sigma_{(h)1}^{\ n} \mathrm{A}'_{h,r}\, \mathrm{A}'_{h,1} = 1, \text{ or } = 0,$$

according as $r = 1$ or > 1, we may make

$$\mathrm{P}_t = \mathrm{A}'_{h,1} \sin ts_1, \quad \mathrm{Q}_t = \mathrm{A}'_{h,1} \cos ts_1,$$

$$\mathrm{L}_t = k'\mathrm{A}'_{h,1} \sin(ts_1 - kx), \quad \mathrm{M}_t = k'\mathrm{A}'_{h,1} \cos(ts_1 - kx)$$

and

$$\left.\begin{array}{l}\xi_{g,h,t} = \tfrac{1}{2}\mathrm{X}'_1\mathrm{A}'_{h,1} \\ \left\{\cos(\epsilon'_1 + ts'_1 - k'x) + \int_{-\infty}^{\infty} dk\,\frac{\sin(\epsilon'_1+ts_1-kx)}{\pi(k-k')}\right\},\end{array}\right\}\quad(21)$$

that is, nearly, if x be considerably different from $t\frac{ds'_1}{dk'}$,

$$\left.\begin{array}{l}\xi_{g,h,t} = \tfrac{1}{2}\mathrm{X}'_1\,\mathrm{A}'_{h,1}\cos(\epsilon'_1 + ts'_1 - k'x) \\ \left\{1 + \int_{-\infty}^{\infty}\frac{dk}{\pi k}\sin\left(\left(t\frac{ds'_1}{dk'} - x\right)k\right)\right\}.\end{array}\right\}\quad(21)'$$

We have therefore the approximate expressions:

$$\xi_{g,h,t} = \mathrm{X}'_1\mathrm{A}'_{h,1}\cos(\epsilon'_1 + ts'_1 - k'x),\ \text{if } x < t\frac{ds'_1}{dk'};\quad(22)$$

and

$$\xi_{g,h,t} = 0,\ \text{if } x > t\frac{ds'_1}{dk'};\quad(22)'$$

we have also nearly, in general,

$$\xi_{g,h,t} = \tfrac{1}{2}\mathrm{X}'_1\mathrm{A}'_{h,1}\cos(\epsilon'_1 + ts'_1 - k'x),\ \text{if } x = t\frac{ds'_1}{dk'};\quad(22)''$$

but the discussion of the case when x is nearly $= t\frac{ds'_1}{dk'}$ is too long to be cited here. The formula (22) for $\xi_{g,h,t}$ coincides with the particular integral (4)'; and the condition which it involves with respect to x, expresses the law according to which this particular integral comes to be (nearly) true for greater and greater positive values of x and t, (if $\frac{ds'_1}{dk'} > 0$,) after having been true only for negative values of x when t was $= 0$.

In the particular case $n = 3$, the foregoing formulæ have an immediate dynamical application, and correspond to the propagation of vibratory motion through a system of mutually attracting or repelling particles; and they conduct

to this remarkable result, that the velocity with which such vibration spreads into those portions of the vibratory medium which were previously undisturbed, is in general different from the velocity of a passage of a given phase from one particle to another within that portion of the medium which is already fully agitated; since we have

$$\textit{velocity of transmission of phase} = \frac{s}{k}, \qquad \text{(A)}$$

but

$$\textit{velocity of propagation of vibratory motion} = \frac{ds}{dk}, \qquad \text{(B)}$$

if the rectangular components of the vibrations themselves be represented by the formulæ

$$\text{x}\text{A}_1 \cos(\epsilon + st - kx), \text{x}\text{A}_2 \cos(\epsilon + st - kx), \text{x}\text{A}_3 \cos(\epsilon + st - kx), \quad \text{(C)}$$

t being the time, and x being the perpendicular distance of the vibrating point from some determined plane.

This result, which is believed to be new, includes as a particular case that which was stated in a former communication to the Academy, on the 11th of February last, (Proceedings, No. 15, page 269,) respecting the propagation of transversal vibration along a row of equal and equidistant particles, of which each attracts the two that are immediately before and behind it; in which particular question s was $= 2a \sin \frac{k}{2}$, and the velocity of propagation of vibration was $= a \cos \frac{k}{2}$. Applied to the theory of light, it appears to show that if the phase of vibration in an ordinary dispersive medium be represented for some one colour by

$$\epsilon + \frac{2\pi}{\lambda}\left(\frac{t}{\mu} - x\right), \qquad \text{(C)}'$$

so that λ is the length of an undulation for that colour and

for that medium, and if it be permitted to represent dispersion by developing the velocity $\frac{1}{\mu}$ of the transmission of phase in a series of the form

$$\frac{1}{\mu} = \text{M}_0 - \text{M}_1\left(\frac{2\pi}{\lambda}\right)^2 + \text{M}_2\left(\frac{2\pi}{\lambda}\right)^4 - \&c., \qquad (\text{A})'$$

then the *velocity wherewith light of this colour conquers darkness*, in this dispersive medium, by the *spreading of vibration into parts which were not vibrating before, is somewhat less than* $\frac{1}{\mu}$, being represented by this other series

$$\text{M}_0 - 3\text{M}_1\left(\frac{2\pi}{\lambda}\right)^2 + 5\text{M}_2\left(\frac{2\pi}{\lambda}\right)^4 - \&c. \qquad (\text{B})'$$

For other details of this inquiry it is necessary to refer to the memoir itself, which will be published in the Transactions of the Academy, and will be found to contain many other investigations respecting vibrating systems, with applications to the theory of light.

The two golden torques found at Tara, and exhibited on a former occasion by Mr. Petrie (see PROCEEDINGS, p. 274), having been purchased from Messrs. West by subscription, they were this evening presented to the Academy by Mr. Petrie, in the name of the subscribers.

It was RESOLVED—That the Subscription List be printed* in the PROCEEDINGS; and that the marked thanks of the Academy be given to those gentlemen, who, not being members thereof, joined in the subscription.

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* It will be found under the head of *Donations*.

The President delivered the following Address:

Before the present session closes, as it is now about to do, I am to inform you, that your Council have continued to consider the expediency of awarding any medal or medals, from the resources of the Cunningham Fund, to any of the papers which had been communicated to us for publication, within the last few years, and which had not previously been so distinguished; adopting still the same plan of triennial cycles, and the same principles connected with that plan, which have been announced to you on former occasions; and thinking themselves bound to lean rather to the side of caution, than to that of indulgence, in deliberating on questions of this kind. The award of a medal, in the name of a learned body, is attended with a grave responsibility. It does not indeed pronounce, in the name of the Society, on the rigorous accuracy, or perfect novelty, of the paper which is thus marked out; but it at least offers the peculiar thanks of that Society to the author of that paper, and expresses a desire, on the part of the body, to be connected, to a peculiar degree, in present observation and in future history, with the communication for which the honour is awarded. The withholding of a medal is, for the converse reason, no expression of unfavourable opinion, nor any denial of the existence of a large share of positive merit in the paper or papers which it is thus forborne to distinguish: even when the principle of competition does not happen to come into play, and when no other essay, of the same class and cycle, is adjudged to have superior pretensions. It has, however, appeared to your Council, that they were authorized and bound to award a medal to Mr. Petrie, for his Paper on the History and Antiquities of Tara Hill, printed in the Second Part of the Eighteenth Volume of the Transactions of this Academy; as being, in their opinion, the most important of those which were communicated to us, during the three years ending with December, 1838, in the departments of Polite Literature and Antiquities; and as possessing also such amount of positive merit and interest as to entitle it to this mark of distinction. Having attended the discussions which took place in the Committees on the merits of the various papers, and on Mr. Petrie's Essay in particular, I shall venture

now to lay before you, in the briefest possible manner, a few of the grounds of this award; without attempting to offer a complete statement of those grounds, or anything approaching to a full analysis of the memoir itself, which memoir indeed will very soon be in your hands.

Mr. Petrie's Essay may be considered as consisting of two principal parts: the first containing an account of Events connected with Tara, compiled from Irish manuscripts and illustrative of the History of Ireland; and the second part being devoted to an identification of the existing Remains, including an examination of the various descriptive notices also contained in ancient Irish manuscripts. The documents brought forward, possess a great degree of curiosity and interest; many of them, also, are now for the first time published; and (which is of importance to observe) are given in an entire, unmutilated form; accompanied with literal translations, and with philological and other notes, adapted to increase their value to the student of the ancient literature and history of Ireland. And what gives to these literary relics a value and an interest perhaps greater than, or at least different from, what might attach to them if considered merely as curious fragments, illustrative of the mode of thinking and feeling in times long passed away, is the circumstance that the accuracy of their topographical descriptions has been tested by recent and careful examination. The resources of the Ordnance Survey have been called in, to check or to confirm, by appeal to existing vestiges, the statements still preserved of the writers of former centuries, respecting the relics of what was even then an ancient and almost forgotten greatness; the time-worn traces have been measured, and compared with those old descriptions; and an agreement has been found, which establishes as well the truly wonderful antiquity of the remains still to be found at Tara, on what was once, and for so many centuries, the royal hill of Ireland, as the correctness and authenticity of documents, which it has been little the fashion to esteem.

It is this clear establishment of the authenticity of what had been commonly thought doubtful, this employment of a manifestly rigorous method of inquiry in what had seemed to many persons a region of fancy and of fable, in a word this evident approach to the character of scientific proof, which has made (I own) a stronger impression on

my own mind, and (I believe) on the minds of others too, than even the literary and antiquarian interest of those curious and valuable details (such as the Hymn of Patrick, and the particulars respecting the Lia Fail, or ancient Coronation Stone of Ireland,) brought forward in the present Essay. I shall not venture here to give utterance to any opinion respecting the extent to which the once common and still lingering prejudice against the value and authenticity of Irish Manuscripts, almost against the very existence of any ancient History or Literature of Ireland, may have been removed or exposed before, by the labours of other antiquaries. But it may be allowed me to express a conviction, that it is only by pursuing some such plan as that exemplified in Mr. Petrie's Essay, namely, by a diligent examination of existing Irish Manuscripts, and of existing Irish Remains, and by an unreserved publication of all which may be found in the one and in the other, that full historic certainty can be attained, respecting the ancient state of Ireland. And that if, on the other hand, this diligent search be made, and this full and free publication, they will not fail to produce a clearness and convergence of opinions, among all who attend to these subjects; and will throw such a steady light, not on Irish History alone, but on other cognate histories, as will repay the labour and expense required for such an enterprize.

The Royal Irish Academy has already, from its limited means, contributed much to accomplish this object, or to prepare materials for accomplishing it. By purchase or transcription, we have gradually collected originals, or carefully collated copies, of many of the most valuable manuscripts which are extant, in the ancient Irish language. At a no slight expense, our volumes of Transactions have been and still continue open to receive such fruits of diligent and judicious research, in this department of study, as are contained in the paper on Tara. The sum which, by a recent vote, has been placed at the disposal of the Council, will enable them to push on with vigour the printing and engraving of that other elaborate work of the same author, which was honoured with the award of a medal here some years ago,—the Essay (by Mr. Petrie) on the Round Towers of Ireland. And the liberality of Members concurs with that of extern Subscribers to place, from time to time, upon our table, such splendid donations of ancient Irish Relics, as the Cross and the Torques of this evening.

It is, however, to the resources of the Nation that we must look, to aid us in accomplishing what is truly a national object. As it was long ago pronounced to be a symptom of the health of a State, and an element in its well-being, that all should interest themselves in the weal of each, and that if one member suffer, the whole body should suffer with it; in order that thus whatever injury was offered to a part might be repelled by the energy of the whole, and that every limb might be animated by one pervading vigour: so too it is another fruit and sign of the dignity and happiness of brotherhood, another opposite and contrast to the misery of savage isolation, when not the present only of a nation's life, but the past and future also are regarded with a vivid interest; and, caring for posterity, men care for their ancestors likewise. Each people owes it to the human race, to do what in it lies for preserving its own separate history, and guarding its own annals from decay: and each, according to its power, should cheer and help the rest in their exertions to accomplish this, which is an object common to all. Ireland is rich in records of an ancient civilization; and looks with a just hope to Britain for assistance towards rescuing those records from oblivion, and from the risk of perishing obscurely. Though this Academy possesses many manuscripts, and although many are contained in the Library of our national University, enough has not been done until they have been placed beyond all danger of destruction, and made accessible to students every where, by printing and by publishing them, with notes and with translations, such as can be supplied by some of the few persons who are now versed in the ancient Irish Language. For doing all this well, opportunities can now be had, which the lapse of a generation may almost remove, which the casualties of each year may diminish.

We have had more occasions than one to hear, this evening, of the assistance recently and wisely given by Government to Science. Nor ought (I think) the presence of the representative of our Sovereign and Patron, to restrain me from avowing the hope, in which you all will join, that our desire, long since expressed, for the publication of our Irish Records, may after no long time be granted; and that the State may soon resolve to undertake, or to assist in undertaking, a task for which the materials and the labourers are ready, but of which

the expense, though to a Nation trifling, is too great for an Academy to bear.

Of the possibility of accomplishing that task, and of the fruit which may be expected from so doing, if a proof and specimen sought, they may be found in that Essay, on the History and Antiquities of Tara Hill, for which I now, in the name of this Academy, present this Medal to its Author.

The President then delivered the Gold Medal to George Petrie, Esq., R.H.A., M.R.I.A., and the Academy adjourned to November.

DONATIONS.

The Cross of Cong. Presented by Professor Mac Cullagh.

Bulletins de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles. Presented by the Academy.

Two golden Torques found at Tara. Presented by the Subscribers.

LIST[a] OF SUBSCRIBERS TO THE TORQUES.

*The Gentlemen whose names are marked thus *, are not Members of the Academy.*

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PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY,

FOR THE YEAR 1839–40.

PART IV.

DUBLIN:
PRINTED BY R. GRAISBERRY,
PRINTER TO THE ACADEMY.
MDCCCXLI.

GEOLOGICAL DUBLIN SOCIETY.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1839. No. 19.

November 11.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

William Hill, Esq., and John A. Bowles, Esq., were elected Members of the Academy.

Mr. Morrison, by permission of the Academy, read a statement of the nature and objects of the Institute of Architects of Ireland.

RESOLVED,—That the Academy has heard with pleasure of the establishment of this institution, and shall be always happy to learn the prosperity of an establishment connected essentially with the progress of an art so important to the best interests of society.

Mr. Ball read a paper "on the Bolina Hibernica," by Robert Patterson, Esq., Member of the Natural History Society of Belfast.

In a note appended to his paper on the Cydippe Pomiformis, (Trans. R. I. A., vol. xix., part 1, page 96), the author had mentioned the occurrence on the Irish coast of a species of ciliograde, which he had named provisionally *Bolina Hibernica.* A large number having been taken in the bay of Bangor, county of Down, on the 11th of July, 1839, the

drawings now brought forward were executed from living specimens.

The movement of this Beroë was stated to be less vivacious than that of the Cydippe pomiformis, and it is much more susceptible of external injury. The long-continued action of certain portions of the cilia, after the animal was broken to pieces, was mentioned; the variety of aspect presented by the tentacula described; and the situation of certain whitish cords or vessels minutely detailed. The lobes of the mouth were shown by the figures not to occupy more than one-fifth of the entire length. The body is transparent, and, when agitated in the dark, becomes highly luminous—a property not possessed after death.

In conclusion, the author enumerated the localities in which it had been hitherto observed, and proposed some brief specific characters by which it might be distinguished.

Rev. Dr. Dickinson gave a verbal account of a remarkable waterspout, which he had observed at Killiney during the last summer.

Towards the end of the month of July, about 10 A. M., while standing on the shore of the bay of Killiney, his attention was directed by a friend to a waterspout, distant about a quarter of a mile from the land. It was not similar in form to the representations of waterspouts usually given, and may therefore deserve to be noticed. It was shaped like a double syphon, the whole being suspended at a considerable elevation in the air; the longer end of the syphon reached towards the sea, and appeared to approach it nearer and nearer, till, at length, its waters were distinctly seen rushing into the deep. The loop gradually lowered, as if sinking and lengthening by its own weight, while the upper part of the syphon seemed not to lose in elevation. At length the loop burst, and there were three streams of water pouring into the sea, two of those streams still continuing

united by the arch at the top. The breadth of these streams gradually diminished till they became invisible, but their length seemed undiminished as long as they were at all seen. The quantity of water poured down must have been very considerable, as the bubbling of the sea beneath could be distinctly observed.

Dr. Dickinson was informed that a waterspout fell a few days after inland, towards the Three-Rock mountain. It is said to have done some injury; but his informant did not see it, and he could not, therefore, ascertain its shape.

DONATIONS.

Memoires de l'Institut de France, Sciences Morales et Politiques. Tom. II., Serie 2. Presented by the Institute.

Comptes Rendus Hebdomadaires des Seances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. Nos. 24 and 25. Premier Semestre, 1839; Nos. 1—19. Deuxieme Semestre, 1839. Presented by the Academy.

Memoires de l'Académie Impériale des Sciences de St. Petersbourg. Serie 6.

Sciences Mathematiques, &c. Tome IV., Liv. 1 et 2.

Sciences Politiques, &c. Tome IV., Liv. 1, 2, et 3.

Par Divers Savans. Tome IV., Liv. 1 et 2.

Recueil des Actes de l'Académie Impériale des Sciences de St. Petersbourg. 1837.

Presented by the Academy.

Memoires de la Societe Geologique de France. Tom. III., Partie 2. Presented by the Society.

Oversight over det Kongelige Danske Videnskabernes Selskabs Forhandlinger og dets Medlemmers Arbeider i Aaret. 1838.

Collectanea Meteorologica sub auspiciis Societatis Scientiarum Danicæ edita. 1839.

Presented by the Royal Society of Copenhagen.

Transactions of the American Philosophical Society, 1839. Vol. VI., Part 2. Presented by the Society.

Proceedings of the American Philosophical Society. No. 7. Presented by the Society.

Journal of the Franklin Institute, for 1839. Vol. XXIII. Presented by the Society.

Proceedings of the Royal Society, No. 39. Presented by the Society.

Transactions of the Royal Society of Edinburgh. Vol. XIV., Part 1.

Proceedings of the Royal Society of Edinburgh. Nos. 13, 14, and 15.

Presented by the Society.

Proceedings of the Botanical Society of London. Vol. I., Part 1. Presented by the Society.

Proceedings of the Committee of Commerce and Agriculture of the Royal Asiatic Society. Presented by the Society.

Transactions of the Royal Society of Literature. Vol. III., Part 2. Presented by the Society.

Proceedings of the Numismatic Society of London, for 1837 and 1838. Presented by the Society.

Reports of the British Association for the Meetings held in Dublin and Newcastle. Presented by the Association.

Ordnance Survey of Kildare. 42 Sheets, &c. Presented by his Excellency the Lord Lieutenant.

The second, fourth, and fifth Reports of the Commissioners for the Improvement of the Navigation of the Shannon. 4 Vols. Presented by the Secretary for Ireland.

A Manuscript, entitled " Esquisse d'une Histoire primitive des îles Britanniques." By the Baron De Donop, Hon. M.R.I.A. Presented by the Author.

On a new Species of Entomostraca. By F. M'Coy, Esq. Presented by the author.

Derrick's Letters. Presented by Aquilla Smith, M.D.

A modern Irish Manuscript, containing Poems by John O'Connell, Owen O'Rathaile, and others. Presented by the Rev. Edward Marks.

A Review of Lyell's "Elements of Geology." Presented by Dr. Fitton.

Tracts on Docks and Commerce, &c. By Wm. Vaughan, Esq., F.R.S. Presented by the author.

A Narrative of Captain D. Woodard's Sufferings and Escape from the Malays, &c. Presented by William Vaughan, Esq.

Memoir of Nathaniel Bowditch, LL.D. By his son, N. J. Bowditch, Esq. Presented by the author.

Report on the Magnetic Isoclinal and Isodynamic Lines in the British Islands. Presented by the contributors.

The Herald of Peace. Nos. 1—7. Also, *a Volume of Tracts of the Peace Society.* Presented by Joshua Abell, Esq.

Sketch of the Geology of North America. By Charles Daubeny, M.D., &c. Presented by the author.

Rara Mathematica. Edited by James Orchard Halliwell, Esq., F.R.S., &c. Presented by the Editor.

Halliwell's Hints to Novices in Manuscript Literature. Presented by the author.

Dublin Metropolitan Police Report for 1838. Presented by the Commissioners of Police.

ANTIQUITIES PRESENTED.

The Lower Stone of an ancient Mill. Presented by Arthur Hatfield, Esq.

A Bronze Belt, of a peculiar form. Presented by Henry Watson, Esq.

An ancient Spear Head.

November 30 (Stated Meeting.)

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

Mr. Herrick presented to the Academy an ancient wooden vessel, found at a considerable depth in Meenskehy bog, near Mill-street, in the county of Cork. Mr. Herrick observed that some gold ornaments, and a brazen spear head, had been found some years ago in the same locality.

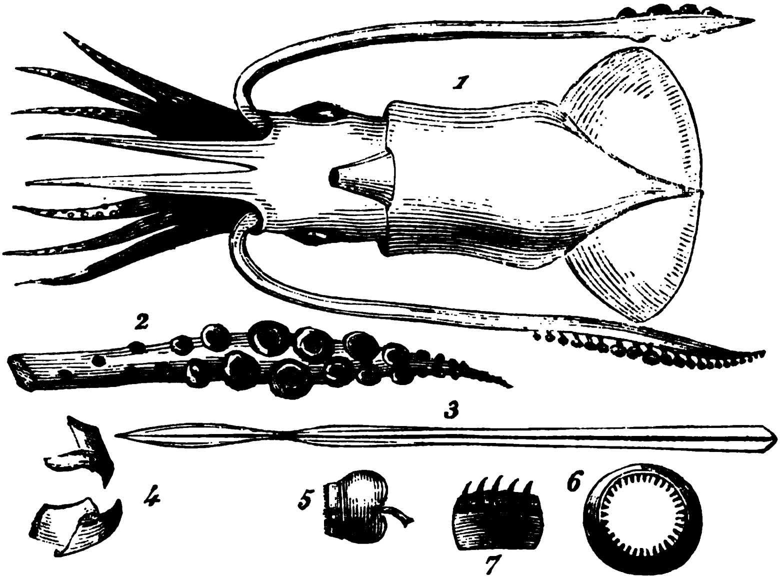
The thanks of the Academy were returned to Mr. Herrick for his donation.

Mr. Ball read a paper "on a Species of Loligo, found on the Shore of Dublin Bay."

After some general observations on the importance and interest attached to the study of cephalopodous Mollusca, the author proceeded to state, that about three years since the subject of his paper was brought to him, with other rejectamenta of the sea, collected after a storm, by his friend, T. W. Warren, Esq. Finding that it was not of a species recorded as British, he endeavoured in vain to trace a description of it in foreign works; he therefore, but not without hesitation, presumed it to be nondescript. Its dimensions are the following:—

Extreme length, to the end of tentacula,	10.0	inches.
Do. of the body or mantle,	3.1	„
Do. of the head, ...	1.6	„
Average length of arms, ...	2.8	„
Length of tentacula, ...	6.0	„
Breadth of fin, ...	3.0	„
Length of fin, ...	1.3	„
Extreme breadth of body, ...	1.7	„
Length of dorsal lamina, ...	3.5	„
Extreme breadth of dorsal lamina, . . .	0.2	„

Breadth of largest horny hoops of acetabula, about . . . . 0.2 inches.



Reference to the Diagrams.

1. Figure of Loligo Eblanæ, half the natural size.
2. Termination of tentacula, with acetabula, natural size.
3. Dorsal lamina, natural size.
4. Beak, natural size.
5. Magnified figure of an acetabulum, or sucker, to show its peduncle.

6, 7. Magnified figures of horny hoops of acetabula.

It was thus shown to be of much shorter proportions than the Loligo vulgaris. Its body is urn-shaped. The large fin, which is somewhat inequilateral, approximates to an ellipse in form, and resembles not a little the fin of Loligo Brongnartii, as figured by Ferussac, to which it also bears likeness, in the structure of its five-ribbed dorsal lamina; but it differs from this animal in its general proportions, and in the horny hoops of its acetabula, which have in each of the

twelve largest in the tentacula about thirty-six sharp and equal teeth. The general form of the whole animal much resembles Onychoteuthis Leachii—a cephalopod of a different genus, with which it may be confounded by a casual observer. Mr. Ball proposed to name the species Loligo Eblanæ.*

In addition to the foregoing, the following species of Loligo have fallen under Mr. Ball's notice, as occurring in the Irish seas :—

Loligo sagittata var. differing in the shortness of its tentacula from the figure given by Ferussac. Several specimens were taken off the coast of Cork by George Allman, Esq.

Loligo vulgaris.

Loligo media.

Loligo media var.—easily distinguished by its greater proportionate length of body, and by the shortness of its tentacula, from the true L. media; in the form of the fin ternating its mantle, it strongly resembles Loligo subulata. A few specimens, obtained on the coast of Down by the late J. Montgomery, Esq., were submitted to Mr. Ball's inspection by W. Thompson, Esq.†

Mr. Clarke read a paper "on atmospheric Electricity."

The author commenced his paper with a description of the apparatus which he had employed in the experimental investigation of this subject. He showed the inapplicability of the electrometers hitherto employed, and exhibited an

* The ancient name of Dublin.

† Since the foregoing was written, Mr. Ball was favoured with an inspection of Cuttle-fish bones, found at different times on Magilligan Strand, county of Derry, by Mr. Hyndman, of Belfast. They seem to be those of Sepia rupellaria, figured in Ferussac's third plate of Sepia. His attention was also directed to beaks of Cuttle-fish, found in the stomachs of Delphinus melas and Hyperoodon bidens. They belonged to a species of Cephalopod he has not yet determined. As he purposes writing a monograph of the Cephalopoda of the Irish seas, he requests information on the subject from all who can afford it.

highly insulated galvanometer, containing about three thousand turns of very fine wire covered with silk, varnished and baked,—which instrument, although exquisitely sensitive to the feeblest voltaic electricity, was not at all acted upon by atmospheric electricity of the low tension which exists during serene weather in this country. Mr. Clarke added, that although the application of such an instrument would be a great desideratum in experiments on atmospheric electricity, and in this point of view had been recommended by the highest scientific authorities in Europe, yet he had reason to think that it had never, in any country, been deflected by atmospheric electricity in serene weather.

The author then exhibited the electrometer which he had devised for, and used in his experiments on this subject. It consisted of a bell of glass, seven inches in diameter, through the side of which passed a sliding graduated rod, furnished with a vernier, which indicated the distance, in hundredths of an inch, through which a single pendent slip of leaf gold was attracted towards the rod which was in connexion with the earth. The slip of leaf gold was attached to a vertical and well insulated rod, which passed through a collar of leathers, and could therefore be raised or depressed, as required by the varying intensity, so that the lower end of the leaf should always, when electrified, be a tangent to the ball terminating the graduated rod.

The author then alluded to the received opinion, that the Aurora Borealis is an electric discharge of considerable intensity occurring near the polar regions, at great heights in the atmosphere, where the air is necessarily rare, and where, consequently, the electric light (as shown in our artificial imitation of the phenomenon) must be very much diffused and ramified. Hoping to throw light upon this subject, he had made a series of observations on the electric intensity of the twenty-four hours, commencing at mid-day on the 12th of November, 1838, and continued at intervals of fifteen

minutes,—except during the appearance of the Aurora, when they were made every five minutes, and even oftener. The results of these observations were laid down in a chart, which exhibited the intensity of the electric fluid during these twenty-four hours, a period including that of the magnificent crimson Aurora, which was observed on the night of the 12th, and morning of the 13th of November, 1838, over every portion of the globe. It appeared, by this chart, that the electric intensity during the existence of this magnificent display of Auroral light was but little above the mean electric intensity of that hour during the month; from which the author inferred that this phenomenon, if at all electric, occurred at such a distance as to be unable to affect the apparatus.

The author then proceeded to give an account of the extended series of experiments which he had undertaken at the recommendation of the Academy, and which he had continued during twelve months, at intervals of fifteen minutes, during at least ten days, and from three to seven nights in each month. He stated, that when he had undertaken this series of experiments, he had the following objects in view—namely, to determine the mean amount of electric intensity existing in this country, at the different hours of day and night, and the periods of maxima and minima; and, secondly, to endeavour to trace the cause of this varying intensity to the influence of some of the recognised agents in nature,—such as the variations of atmospheric pressure; the variations of temperature; or the varying quantity of vapour in our atmosphere.

He was happy to announce, that he had not only determined the mean monthly, and annual force of electricity at the several hours of the day and night, but also had succeeded in establishing its dependence upon two, out of the three agents, with which he had originally proposed to investigate its connexion. The two with which he has established its

connexion and proved its dependence are, *temperature,* and the total *quantity of moisture* present in the air, as shown by the dew point. Indeed these two phenomena, as the author remarked, are referrible to each other, the temperature producing evaporation, and the force of electricity at any period being shown to be almost exactly proportional to the tension of the vapour so produced.

The hour of the first electric minimum was shown to be about 3 A. M., the electricity increasing with the temperature until 10 A. M., when a slight decrease occurred; the electric tension again commences rising at about 11 A. M.; and continues to increase until about 2^h 45^m, P. M.—all these movements being in exact proportion to the elevation of the dew point and temperature. At 3 P. M. the dew point and temperature begin gradually to lower, as does also the electricity (but not so quickly); but from 5 to 7 P. M., the electric intensity rises, being acted upon and increased by the precipitation of the evening dew, which has set free the latent electricity of the condensed vapour, in conformity with the experiment of Volta. Again, from 7 P. M., the electric intensity weakens rapidly, and descends in common with the dew point and temperature, until they all reach their minimum about 3 A. M.

Thus the patient investigation of this subject has laid bare the cause of the varying diurnal intensity of the electric fluid,—showing it to be the result of evaporation, which, besides its agency in carrying the electric fluid from our earth to the upper regions of the air, daily returns it to us by the conducting power of this vapour, in the direct proportion of its quantity.

Dr. Smith read a paper "on the Irish Coins of Edward the Fourth," the chief object of which was to endeavour to fix the dates of the numerous coinages of this reign with more precision than had been attained before.

The coins were divided into four sections, each distinguished by its peculiar type,—the Irish, the Anglo-Irish, the English, and the coins with three crowns on the reverse.

In the first section the author pointed out the distinctions not previously recognised, between the groats and the pennies of Henry the Sixth, and those of Edward the Fourth, and showed that some of Edward's coins have been heretofore erroneously appropriated to Henry the Sixth.

In the second section proofs were adduced in corroboration of Mr. Lindsay's opinion concerning the date (1465) of the coins engraved in Snelling's Supplement to Simon, Pl. I. Figs. 18, 19, and also that the coinage of 1467 was erroneously described by Simon as having "a crown on one side," instead of "a face and crown." Two unpublished and unique specimens of this coinage were described,—the double groat of Drogheda, the earliest coin known from this mint, in the cabinet of the Rev. Mr. Butler of Trim; and the half groat of Trim, in the cabinet of the Dean of St. Patrick's. Some remarks were made on the difference between the Tower and the Troy pound, which have been frequently confounded by the writers on Irish coins.

The coins with the King's head on the obverse, and a rose, instead of pellets, in the centre of the reverse, Dr. Smith considers to have been coined in 1470; and he supported his opinion by reference to the Act of the first of Richard the Third, and by other evidence.

In the third section, two unpublished and unique coins were described,—the half groat of Drogheda, in the Dean of St. Patrick's cabinet; and the half groat of Trim, in that of the Rev. Mr. Butler;—and some reasons were assigned to show that the letter G, which is found on most of the groats of Drogheda, Dublin, and Waterford, was the initial of Germyn Lynch, the master of the mint.

In the fourth section Dr. Smith remarked that Sir James Ware, or the writers since his time, had not given any ex-

ılanation of the meaning of the term "cross-keele groats;" ınd stated his opinion that it was the Irish word cροċ caol, cross-keale, or slender cross,) and that it was applied by he native Irish to distinguish the groats of this period from he other kinds with a broader cross, which were in circula- ion. There are many instances of coins being denominated 'rom some peculiarity of their type, e.g. Angel, Salute, Harpers, &c.

Many other points of interest to numismatists were fully :onsidered in this communication, and accurate drawings of :he coins described were exhibited.

Dr. Apjohn read a note by George J. Knox, Esq., "on :he oxidating Power of Glass for Metals, and on the want ›f Transparency in ancient Glass."

"In a late work, which treats of the manufacture of glass, ın experiment of Guyton Morveau is mentioned, in which ɜix per cent. of copper filings having been mixed with pounded glass, and the compound completely melted, it was 'ound to have assumed a red colour uniformly diffused ;hroughout the mass, so deep as to render the glass nearly ›paque. The experiment originated from a workman in the glasshouse having dipped a heated copper ladle into a pot of fused glass. The copper ladle was melted; the casting ınd annealing of the plates were proceeded with as usual; ınd on their completion the workmen were surprised to find, that not only were grains of metallic copper embedded in :he substance of the glass, but bands uniformly coloured of a fine bright red, were distributed throughout the mass.

"The experiment of Guyton Morveau, being but a repetition of the accidental one made by the workman, seems to have but little engaged his attention, the colour being conceived to be due to an *imperfect* state of oxidation, as oxide of copper imparts to glass a greenish colour.

"It appeared to me, at first sight, that the red colour was

due to the actual solution of the copper in the metallic state, the globules of copper imbedded in the mass having been deposited from a state of solution, upon cooling. To determine this, I mixed in different proportions with powdered glass, iron, lead, copper, silver, bismuth, antimony, tin, gold, platinum, in a minute state of division; and found that glass, when mixed with iron filings, will oxidate and dissolve almost as much iron, when mixed with it in the metallic state, as if it were mixed with it in the state of oxide. Of copper, only a small proportion is oxidated and dissolved, imparting a green colour to the glass, while the rest remains disseminated throughout the glass in globules of copper and red streaks, which are probably the protoxide; whereas lead (for whose oxide glass has such a strong affinity) oxidates but a small portion, when mixed with it in the metallic state, the rest being found imbedded in globules throughout its mass. Tin, antimony, and bismuth are more easily oxidized and dissolved than lead. Gold, when fused with glass, imparts to it a light greenish tinge, increasing in depth with the relative proportion of silica in the glass,—producing a deeper colour with the bisilicate than the silicate of potash, and still deeper when German glass (which contains a large proportion of silica) is employed; globules of gold are found (as in the analogous cases of lead and copper) disseminated throughout the mass. If the heat be increased, and the crucible containing the gold be left for some hours in the furnace, the glass assumes a pinkish hue, which is the colour imparted to it by the protoxide of gold. When platinum sponge is fused with glass, it sinks to the bottom of the crucible unaltered, owing to its infusibility. When charcoal is heated with glass, a large proportion is oxidated, the remainder presenting the appearance of a mechanical mixture.

"From these experiments it appears that glass, at high temperatures, not only has the property of oxidating the metals, and forming a chemical compound with the oxide, but

moreover, when the chemical affinity is satisfied, of dissolving the oxides, and probably the metals themselves when in a state of fusion; the latter, on the cooling of the glass, being deposited in globules throughout its interstices, (at least the appearance presented by the glass seems to favour such an opinion.)

"The colours produced by the fusion of metals with glass, being different in many cases from those obtained when their oxides were employed, and presenting the dull untransparent appearance which is so remarkable in ancient glass, led me to suppose that the ancients did not employ any colouring matter unknown at the present day, but that, being unacquainted with the mineral acids, they employed the metals either in the metallic state, in filings, or else in an imperfect state of oxidation. To determine the probability of this conjecture, I selected three specimens of mosaic glass, analyzed by Klaproth; and substituting for the oxides, in the same relative proportion, the metals in a minute state of division, I obtained coloured glasses of nearly the same colour as the mosaics, while the colours produced when the oxides were employed were not only perfectly different, but the glasses were clear and transparent.

"One of a lively copper red, opaque and very bright, contained, in 200 grains, silica 142, oxide lead 28, copper 15, iron 2, alumina 5, lime 3.

"Another, of a light verdigris green, contained, in 200 grains, silica 130, oxide copper 20, lead 15, iron 7, lime 13, alumina 11.

"A specimen of blue glass contained, in 200 grains, silica 163, oxide iron 19, oxide copper 1, alumina 3, lime ½."

The Secretary read a note by George J. Knox, Esq., "on a gaseous Compound of Fluorine and Cyanogen."

When recently ignited fluoride of silver is mixed with several times its weight of dry solid cyanogen, and heated

in a platinum crucible, which fits to one extremity of a platinum tube, to the other extremity of which is adapted a small platinum receiver, (the junction between the latter being rendered air-tight with caoutchouc, and the receiver and tube being immersed in a freezing mixture of ice and snow,) no solid or liquid product is obtained in the tube or receiver; the fluoride of silver is converted into cyanuret of silver; and a gas is evolved, which has a stronger effect upon the eyes and throat than hydrofluoric acid, producing sickness, headache, and vertigo. This gas acts strongly upon glass, reddens litmus, and burns in the flame of a spirit lamp with a yellowish light. It remains for a considerable time in the platinum vessel, showing that its specific gravity is greater than that of atmospberic air.

The same gas is obtained, when a current of gaseous cyanogen is passed over fluoride of silver fused in the platinum tube.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1839. No. 20.

December 9.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

Mr. Clarke read a supplement to his paper "on Atmospheric Electricity."

The author gave in this supplement a more detailed description than he had before done of the mode of insulating the apparatus for experiments on atmospheric electricity, which he had used in the course of his recent researches.

He then described an experiment by which he had shown the absence of decomposing agency in the electricity of serene weather, and stated his opinion of the cause.

Mr. Clarke next directed attention to the fact, that the curve representing the diurnal variation of the barometric column was the reverse of the electric, thermometric, and hygrometric curves. He considered that such a result was to be expected; for the barometric column should naturally be lower from mid-day to 3 P. M. than at midnight, in consequence of the greater quantity of aqueous vapour which exists in the atmosphere at the former than at the latter time,—air charged with aqueous vapour being known to be

of less specific gravity than dry air. Thus the barometric and hygrometric curves would be the inverse of each other, the maxima of the one corresponding to the minima of the other; and as the author had previously shown that the hygrometric, thermometric, and electrometric curves were in accordance, the barometric curve would be the inverse of the thermometric and electrometric curves also. The author remarked, that if this character of the horary oscillations of the barometer in Ireland be confirmed by the experiments of other observers, it will either lead to new views of this phenomenon generally, or show that the quantity of aqueous vapour existing in Ireland is so great as to cause the horary barometric oscillations to present themselves in a different form from that in which they are recognised in drier climates.

The author adverted, in the last place, to the hypothesis of Priestley and Beccaria,—that the upper regions of our atmosphere were the chief depositories of the electric fluid,—an opinion which he conceived must fall, if the origin of atmospheric electricity be due (as his experiments prove) to the existence of vapour; as these elevated parts of our atmosphere are far above the region of permanent vapour, or even of vapour at all.

Professor Mac Cullagh read a paper "on the Dynamical Theory of crystalline Reflexion and Refraction."

In a former paper, presented to the Academy in January 1837, and printed in volume xviii. of the Transactions, the author had reduced all the complicated phenomena of reflexion and refraction at the surfaces of crystals to the utmost regularity and order, by means of a simple rule, comprised in his theorem of the *polar plane*. This rule, which was verified by its agreement with exact experiments, he had deduced from a set of hypotheses relative to the vibrations of light in their passage through a given

medium, and out of one medium into another; but he had not attempted to account for his hypotheses, nor to connect them together by any known principles of mechanics; and the only evidence in favour of their truth, was the truth of the results to which they led. He had observed, however, that these hypotheses were not independent of each other; he had ascertained that the laws of reflexion at the surface of a crystal were connected with the laws of propagation in its interior; and he had thence been led to conclude that all these laws and hypotheses "had a common source in other and more intimate laws not yet discovered." He became impressed, in short, with the idea "that the next step in physical optics would lead to those higher and more elementary principles by which the laws of reflexion and the laws of propagation are linked together as parts of the same system."

This step the author has now made; and the present paper realises the anticipations scattered through the former. Setting out with the general dynamical theorem expressed by the equation

$$\iiint dxdydz\left(\frac{d^2\xi}{dt^2}\delta\xi+\frac{d^2\eta}{dt^2}\delta\eta+\frac{d^2\zeta}{dt^2}\delta\zeta\right)=\iiint dxdydz\delta\mathrm{v}, \quad (1)$$

where ξ, η, ζ, are the displacements at the time t of a particle whose co-ordinates are x, y, z, and where the density of the ether is supposed to be unity, as being constant for all media, the author determines the form of the function v, for the particular case of luminiferous vibrations, by means of the property which may be regarded as distinguishing them from all others—namely, that they take place entirely in the surface of the wave. From this property he shows, in the first place, that v is a function of the three differences

$$\frac{d\eta}{dz}-\frac{d\zeta}{dy},\quad \frac{d\zeta}{dx}-\frac{d\xi}{dz},\quad \frac{d\xi}{dy}-\frac{d\eta}{dx};$$

and, in the next place, that the only part of it which comes into play is of the second order, containing the squares and products of those quantities, with of course six constant coefficients. Then, supposing the axes of coordinates to be changed, he proves that the usual formulæ for the transformation of coordinates apply also to the transformation of those differences; so that, by assuming the new axes properly, the terms in the function V which depend on the products of the differences may be made to vanish, and V will then contain only the three squares, each multiplied by a constant coefficient. The axes of coordinates in this position are defined to be the principal axes, (commonly called the axes of elasticity); and when we put, with reference to these axes,

$$-2\text{V} = a^2\left(\frac{d\eta}{dz}-\frac{d\zeta}{dy}\right)^2 + b^2\left(\frac{d\zeta}{dx}-\frac{d\xi}{dz}\right)^2 + c^2\left(\frac{d\xi}{dy}-\frac{d\eta}{dx}\right)^2, \quad (2)$$

it turns out that a, b, c, are the three principal velocities of propagation within the crystal.

To find the laws of propagation in a continuous medium of indefinite extent, we have only to take the variation of V from the expression (2), and, after substituting it in the right-hand member of equation (1), to integrate by parts, so as to get rid of the differential coefficients of the variations $\delta\xi$, $\delta\eta$, $\delta\zeta$. Then equating the quantities by which these variations are respectively multiplied in the triple integrals on each side of the equation, we obtain the value of the force acting on each particle in directions parallel to the principal axes. The double integrals which remain on the right-hand side of the equation are to be neglected, as they belong to the limits which are infinitely distant. The resolved values of the force thus obtained lead to the precise laws of double refraction which were discovered by Fresnel, with this difference only, that the vibrations come out to be *parallel* to the plane of polarisation, whereas he supposed them to be *perpendicular* to it.

When there are two contiguous media, and the light passes out of one into the other, suppose out of an ordinary into an extraordinary one, and we wish to determine the laws of the reflected and refracted vibrations, it is only necessary to attend to the double integrals in the equation of limits; but the integrations must now be performed with respect to other coordinates. Taking the separating surface of the two media for the new plane of xy, the axis of x being in the plane of incidence, let the principal axis x of the crystal make with these new axes the angles α, β, γ, while the principal axes y and z, in like manner, make with them the angles α', β', γ', and α'', β'', γ'', respectively. Then, marking with accents the quantities relative to the new coordinates, we have

$$\left.\begin{aligned}
\frac{d\eta}{dz}-\frac{d\zeta}{dy}&=\left(\frac{d\eta'}{dz'}-\frac{d\zeta'}{dy'}\right)\cos\alpha+\left(\frac{d\zeta'}{dx'}-\frac{d\xi'}{dz'}\right)\cos\beta\\
&\quad+\left(\frac{d\xi'}{dy'}-\frac{d\eta'}{dx'}\right)\cos\gamma,\\
\frac{d\zeta}{dx}-\frac{d\xi}{dz}&=\left(\frac{d\eta'}{dz'}-\frac{d\zeta'}{dy'}\right)\cos\alpha'+\left(\frac{d\zeta'}{dx}-\frac{d\xi'}{dz'}\right)\cos\beta'\\
&\quad+\left(\frac{d\xi'}{dy'}-\frac{d\eta'}{dx'}\right)\cos\gamma',\\
\frac{d\xi}{dy}-\frac{d\eta}{dx}&=\left(\frac{d\eta'}{dz'}-\frac{d\zeta'}{dy'}\right)\cos\alpha''+\left(\frac{d\zeta'}{dx'}+\frac{d\xi'}{dz'}\right)\cos\beta''\\
&\quad+\left(\frac{d\xi'}{dy'}-\frac{d\eta'}{dx'}\right)\cos\gamma''.
\end{aligned}\right\}\ (3)$$

Now if we take the variations of these expressions, and substitute them in the value of δv derived from equation (2), then multiply by $dx'dy'dz'$, and integrate between the limits $z'=0$ and $z'=\infty$, neglecting to take account of the latter limit, as well as of the integrations with respect to x' and y', of which both the limits are infinite, we shall get, in the equation which holds at the separating surface, a term of the form

$$\iint dx'dy'(\text{Q}\delta\xi' - \text{P}\delta\eta'), \tag{4}$$

where

$$\left.\begin{aligned} \text{P} &= a^2\left(\frac{d\eta}{dz} - \frac{d\zeta}{dy}\right)\cos\alpha + b^2\left(\frac{d\zeta}{dx} - \frac{d\xi}{dz}\right)\cos\alpha' \\ &\quad + c^2\left(\frac{d\xi}{dy} - \frac{d\eta}{dx}\right)\cos\alpha'', \\ \text{Q} &= a^2\left(\frac{d\eta}{dz} - \frac{d\zeta}{dy}\right)\cos\beta + b^2\left(\frac{d\zeta}{dx} - \frac{d\xi}{dz}\right)\cos\beta' \\ &\quad + c^2\left(\frac{d\xi}{dy} - \frac{d\eta}{dx}\right)\cos\beta''. \end{aligned}\right\} \tag{5}$$

This term, along with a similar but simpler one arising from the ordinary medium, must be equal to zero; and as the variations $\delta\xi'$ and $\delta\eta'$ are independent, this condition is equivalent to two. Moreover, the quantities ξ' and η' are to be put equal to the corresponding quantities in the other medium, and thus we have two more conditions, which are all that are necessary for the solution of the problem.

The four conditions may be stated by saying, that each of the quantities P, Q, ξ', η' retains its value in passing out of one medium into another. Hence it is easy to show that the *vis viva* is preserved, and that ζ' likewise retains its value. These two consequences were used as hypotheses by the author in his former paper, and accordingly all the conclusions which he has drawn in that paper will follow from the present theory also.

It will be perceived that this theory employs the general processes of analytical mechanics, as delivered by Lagrange. The first attempt to treat the subject of reflexion and refraction in this manner was made by Mr. Green, in a very remarkable paper, printed in the Cambridge Transactions, vol. vii. part 1. After stating the dynamical principle expressed by equation (1), (though with a different hypothesis respecting the density of the ether,) Mr. Green ob-

serves, that, supposing the function v to be known, "we can immediately apply the general method given in the *Mécanique Analytique*, and which appears to be more especially applicable to problems that relate to the motions of systems composed of an immense number of particles mutually acting upon each other." Such is certainly the great advantage of starting with that general principle; but the chief difficulty attending it, namely, the determination of the function v, on which the success of the investigation essentially depends, has not been surmounted by Mr. Green, who has consequently been led to very erroneous results, even in the simple case of *uncrystallized* media, to which his researches are exclusively confined. In this case Mr. Mac Cullagh's theory confirms the well-known formulæ of Fresnel, one of which Mr. Green conceives to be inaccurate, and proposes to replace by a result of his own, which, however, will not bear to be tested numerically. The present theory applies with equal facility to all media, whether crystallized or not, and is distinguished throughout by the singular elegance and simplicity of its analytical details; a circumstance which the author regards as a strong indication of its truth.

Mr. Lloyd exhibited to the meeting a specimen of a remarkable substance recently found in the principality of Carolath, in Silesia. It formed part of a cloth of 200 square feet in surface now in the possession of the King of Prussia. No description of this substance has yet been published; but Major Sabine and Mr. Lloyd were informed by Baron Humboldt (by whom the present specimen was kindly given) that M. Ehrenberg had examined it microscopically, and had found it to be an organic substance, consisting partly of vegetable and partly of animal matter;—the vegetable component being the *conferva rivularis*, the animal different species of Infusoria, of the family known by the name of *Bacillaria*.

To illustrate the origin of this substance, Mr. Lloyd

read the following note from Major Sabine, respecting a similar body which has been examined and described by M. Ehrenberg.

"In the year 1686, some workmen who had been fetching water from a pond seven German miles from Memel, on returning to their work after dinner, (during which there had been a snow storm,) found the flat ground around the pond covered with a coal-black, leafy, or paper-like mass; and a person, who lived near, said he had seen it fall like flakes with the snow. On examination, some of the pieces were found to be as large as a table, and were lying upon each other to the depth of the thickness of a finger. The mass was damp and smelt disagreeably, like rotten seaweed; but when dried the smell went off. It tore fibrously like paper. Specimens were preserved in several collections, where it was known by the name of *Meteor-paper*, and by many was actually supposed to be a meteoric body. It has been recently examined by M. Ehrenberg, and found to consist partly of vegetable matter, chiefly *conferva crispata*, (common in Germany,) and partly of *infusoria*, of which M. Ehrenberg was able to recognise twenty-nine species. Of these, eight species have siliceous coverings, but the others, which are equally well preserved, were soft-skinned animals; most of them are known as species now existing.

"The Meteor-paper, therefore, as it has been called, was formed in marshy places; had been raised into the air by storms of wind; and had again fallen.

"Substances of the same nature have been found in Norway, in Silesia, and in the Erz Mountains. In some instances they are described as *leathery;* in others as resembling *wadding*, and being white on the upper side and green beneath. They have probably all a similar origin."

Mr. Lloyd also laid on the table of the Academy a specimen of a very similar substance, which he had received

from Sir John Herschel, and which was found investing the rocks at the mouth of one of the rivers of Southern Africa. It resembles the other very much in external appearance, except that the fibres are coarser, and more compactly matted together. It appears to consist almost entirely of *confervæ*, but apparently of a different species.

A paper was read by Mr. J. Huband Smith, descriptive of certain porcelain seals, amounting to upwards of a dozen, found in Ireland within the last six or seven years, and in places very distant from each other.

He exhibited to the Academy one of these seals, with impressions of several others in sealing-wax. He stated that they were all uniform, consisting of an exact cube, having, by way of handle, some animal (probably an ape) seated upon it; and that they were so precisely similar in size and general appearance as to be undistinguishable, except by the characters on the under surface. Little is known respecting these seals beyond the mere fact of their having been found in this country.

An extract from the Chinese grammar of Abel-Rémusat showed that the inscriptions on these seals are those of a very ancient class of Chinese characters, " in use since the time of Confucius," who is supposed to have flourished " in the middle of the sixth century, before J. C." The remote period to which these characters are assigned, leaves open a wide field for conjecture as to the time in which these porcelain seals found their way into this country.

The situations in which some of them have been found are remarkable. One was discovered in ploughing a field near Burrisokane, county of Tipperary, in 1832; another was found last year at Killead, in the county of Down; another in the bed of the river Boyne, near Clonard, in the county of Meath, in raising gravel; and a fourth was discovered many years ago at a short distance from Dublin.

From the extreme degree of heat to which they appear to have been subjected, and the consequent vitrification which has in some measure taken place, they are quite as capable of resisting the attacks of time as the glass and porcelain deities and ornaments found in the mummy cases of Egypt, and may have lain for an indefinite period beneath the surface of the earth. It is therefore, at least, possible that they may have arrived hither from the East, along with the weapons, ornaments, and other articles of commerce, which were brought to these islands by the ships of the great merchant-princes of antiquity, the Phœnicians, to whom our ports and harbours were well known.

Mr. Smith then called the attention of the Academy to the remarkable discovery, by Rosellini, Lord Prudhoe, and other recent travellers, of unquestionable Chinese vases in the tombs of Egypt. He read a passage from Davis's China, in which some of them were described; and also an extract from Wilkinson's Ancient Egyptians, from which it appeared that the number of Chinese vases found at Coptos, Thebes, and elsewhere, amounted to seven or eight, and that the inscriptions on them had been translated by Chinese scholars to mean, "The flower opens, and lo! another year," being a line from an ancient Chinese poem.

From this the trade of China with distant countries, at a period of the remotest antiquity, being clearly proved, Mr. Smith submitted to the Academy that a case of strong probability had been made out, that the porcelain seals found their way into Ireland at some very distant period. In fact, if they be not of modern introduction into this country—a supposition which the situations in which several of them have been found seems utterly to preclude—their arrival here must of necessity have been most ancient.

Mr. Petrie read a paper "on ancient Seals of Irish Chiefs, and Persons of inferior Rank," preserved in the col-

lections of Irish Antiquities formed by the Dean of St. Patrick's, and by himself. He observed that this class of antiquities had been but little attended to by Irish antiquaries—a circumstance which he attributed to the want of general collections of our national antiquities till a recent period: and hence, if the question had been asked a short time since, whether the Irish had the use of signets generally amongst them or not, it would have been impossible to give a decisive answer. This question, however, can now be answered in the affirmative; but the period at which the use of seals commenced in Ireland is still uncertain, as no Irish seals anterior to the Anglo-Norman invasion have been found; or, if found, their discovery has not been recorded. As, however, it is now certain that seals were used by the Anglo-Saxons, it is not improbable that their use may have been introduced into Ireland also—more especially as a remarkable similarity prevailed between the two countries in customs and in knowledge of the arts.

The Irish seals hitherto discovered are similar in style and device to the cotemporary seals of the Anglo-Normans of similar ranks; and, like the secular seals of the latter, are usually of a circular form, whilst the ecclesiastical seals are usually oval.

The seals which Mr. Petrie described or exhibited to the meeting were as follows:—

1. A drawing of an impression from the seal of Felim O'Conor, King of Connaught, as published by Sir James Ware. The device exhibits the figure of Felim on horseback, charging with sword in hand, and the legend reads,

"S. FEDHLIM, REGIS CONACTIÆ."

This prince died in 1265.

2. The seal of Donald Og, the son of Donald Roe Mac Carthy, King or Prince of Desmond, who died in 1309. The device is similar to that of the preceding, and the legend reads,

"S. DONALDI OG FILI. D. ROGH MAC CARTHY."

This seal is in the collection of the author.

3. The seal of Mac Con, Chief of Hy-Caissin, a territory in Thomond, possessed by the family of Macnamara. He died about the year 1350. The device of this seal is also similar to that of Felim, and the legend reads,

"S. MICON DUCIS DE IV. CASSIN."

This seal is in the collection of the Dean of St. Patrick's.

4. The seal of Brian O'Brian, Prince of Thomond, who was killed in the year 1350. The device is a griffin, which appears to have been the heraldic badge of the O'Briens at this period; and the legend reads,

"S. BRIAN I BRIAN."

This seal is also in the collection of the Dean of St. Patrick's.

5. The seal of Murtagh O'Neill, who, as Mr. Petrie believes, was the Lord of Clannaboy of this name, whose death is recorded by the Irish annalists at the year 1471. The device is the bloody hand of O'Neill, and the legend reads,

"S. MAURITIUS UI NIELL."

This seal is also in the collection of the Dean of St. Patrick's.

6. The seal of Mac Craith, the son of O'Dafid. The device is a non-descript animal, and the legend reads,

"S. MAC CRAITH MAC I DAFID."

This seal, which is of the early part of the fourteenth century, appears to belong to the O'Daffy's, a family of the Dal Cais in Thomond, still in existence. The seal is in the collection of the author.

7. The seal of Brian O'Harny, chief of an ancient family in Kerry. The device exhibits the helmeted head of a warrior, cut on a cornelian, and the legend reads,

"S. BRIAN O'HARNY."

This seal is in the collection of the Dean of St. Patrick's.

The material of all these seals is silver.

January 13, 1840.

SIR WM. R. HAMILTON, LL. D., President, in the Chair.

Sir Philip Crampton, Bart., William J. Lloyd, Esq., and John Mollan, M. D. were elected members of the Academy.

Professor Mac Cullagh made a communication respecting the optical Laws of Rock-crystal (Quartz).

In a paper read to the Academy in February 1836, and published in the Transactions, (vol. xvii. p. 461,) he had shown how the peculiar properties of that crystal might be explained, by adding, to the usual equations of vibratory motion, certain terms depending on differential coefficients of the third order, and containing only one new constant c. This hypothesis, which was very simple in itself, not only involved as consequences all the laws that were previously known, but led to the discovery of a new one—the law, namely, by which the ellipticity of the vibrations depends on the direction of the ray within the crystal. He was not able, however, to account for his hypothesis, nor has it since been accounted for by any one.

But the theory developed in the paper which he read at the last meeting of the Academy, now enables him to assign, with a high degree of probability, the origin of the additional terms above-mentioned, and, if not to account for them mechanically, at least to advance a step higher in the inquiry. In that theory it was supposed, (and the supposition holds good in all known crystals, except quartz,) that the molecules of the ether vibrate in right lines, the displacements remaining always parallel to each other as the wave is propagated; and it was shown that the function v, by which the motion is determined, then depends only on the *relative displacements* of the molecules. But when this

is not the case,—when, as in quartz, each molecule is supposed to vibrate in a curve—then it is natural to conceive that the function v may depend, not only on the relative displacements, but also on the *relative areas* which each molecule describes about every other more or less advanced in its vibration. This idea, analytically expressed, introduces a new term v into the value of the function 2v; and, if the plane of the wave be taken for the plane of xy, it is easy to show that

$$v = \text{c}\left(\frac{d\eta}{dz}\frac{d^2\xi}{dz^2} - \frac{d\xi}{dz}\frac{d^2\eta}{dz^2}\right).$$

Now if we integrate by parts the expression

$$\iiint dxdydz\delta v,$$

so as to get rid of the variations of differential coefficients, the reduced form of the triple integral will be

$$2\text{c}\iiint dxdydz\left(\frac{d^3\eta}{dz^3}\delta\xi - \frac{d^3\xi}{dz^3}\delta\eta\right);$$

from which it appears that the quantities

$$\text{c}\,\frac{d^3\eta}{dz^3}, \quad -\text{c}\,\frac{d^3\xi}{dz^3},$$

are to be added to the usual expressions for the force in the directions of x and y respectively. These are the very terms in the addition of which the hypothesis before alluded to consists.

The Secretary read a paper by James Orchard Halliwell, Esq. F. R. S., &c., entitled "an Inquiry into the Period of the first Use of the Zero by those Writers who adopted the Notation of the Boetian numerical Contractions."

The author referred, at the commencement of this communication, to the opinion which he had formerly expressed on the nature of the change from the use of the abacus, to that of local position, and the cipher. This opinion is con-

tained in the following extract: "It would be impossible, with the few materials yet brought to light, to conjecture with any great probability, how far these Boetian contractions may have influenced the introduction, or cooperated with the Arabic system, to the formation of our present numerical notation. It appears to me highly probable that the two systems became united; because the middle age forms of the figure *five* coincide with the Boetian mark for the same numeral, and those of two others are very similar. The idea of local position, again, may have had an independent European origin; the inconveniences of the abacus on paper would have suggested it by destroying the distinguishing boundaries, and inventing an arbitrary hieroglyphic for the representation of an empty square."

The author then proceeded to adduce evidence from some documents recently discovered in support of these views. He showed from the Mentz MS. in the Arundel collection, in what manner the mode of operation with the abacus had been improved, so as to lead naturally to the present system. He then brought forward some passages from MSS. illustrative of the first employment of the zero; and concluded by adducing an instance from a MS. of the translation of Euclid by Athelard, of the fourteenth century, belonging to the Arundel collection, in which the number 15 is written in these contractions, and without a division.

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Catalogue des Principales Apparitions des etoiles filantes. Par A. Quetelet.

Sur l'etat du Magnétisme Terrestre a Bruxelles, pendant les douze années de 1827 *a* 1839. Par A. Quetelet.

Sur la Longitude de l'Observatoire Royal de Bruxelles. Par A. Quetelet.

Presented by the Author.

Asiatic Researches. Vol. XX., Part 2. Presented by the Asiatic Society of Bengal.

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Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Par MM. les Secretaires Perpetuels. Nos. 20-26. Deuxiéme Semestre. 1839. Presented by the Academy.

Transits and Calculations of apparent right Ascensions. 1834.

Zenith Distances observed with the Mural Circle, and Calculations of Geocentric South Polar Distances. 1836 and 1837.

Declinations of the principal fixed Stars, deduced from Observations made at the Observatory, Cape of Good Hope. By Thomas Henderson, Esq.

Observations of Halley's Comet, made at the Royal Observatory, Cape of Good Hope.

Bessel's Refraction Tables.

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By-Laws of the Institute of Architects of Ireland. Presented by the Society.

The Mahawanso, with Translation in English. By the Hon. George Turnour, Esq. Presented by F. B. Norris, Esq., Surveyor General of Ceylon, per I. S. Cooper, Esq.

Medical Report of the Fever Hospital, for 1837-1838. Presented by G. A. Kennedy, M.D.

The Dublin Penny Journal. Nos. 67, 104, Vol. II.; Nos. 191, 198, Vol. IV. Presented by P. Dixon Hardy, Esq.

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* Wall, Rev. Charles William, D.D. Senior Fellow of Trinity College. 20, *College.*

* Wall, Rev. Richard, D.D. 6, *Hume-street.*

Wallace, William Baily, Esq. 63, *Blessington-street.*

* Walshe, Francis Weldon, Esq. *Upper Glentworth-street, Limerick.*

Warburton, Elliott, Esq. 16, *Frederick-street.*

Watson, Henry, Esq. *Limerick.*

* Weaver, Thomas, Esq. F.R.S. F.G.S. 9, *Panton-square, Coventry-street, London.*

* Webb, William, Esq.

Webber, Charles T. Esq. 22, *Upper Gloucester-street.*

* Weld, Isaac, Esq. F.G.S. Sec. Royal Dublin Society. *Ravensville, Bray.*

* Westenra, Hon. H. R.

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Wilde, William R. Esq. 199, *Great Brunswick-street.*

* Wilkinson, James T. Esq.

* Williams, Thomas, Esq. *Drumcondra Castle*, and 38, *Dame-street.*

* Williams, Richard Palmer, Esq. *Drumcondra Castle*, and 38, *Dame-street.*

Wills, Rev. James. *Waterford.*

* Wilmot, Edward, Esq. *Newtown Park, Black Rock.*

* Wilson, Rev. James, D.D. 10, *Harrington-street.*

* Woodward, Benjamin, Esq.

Wyse, Thomas, Esq. M.P. *St. John's, Waterford.*

Young, John T. Esq. *Philpotstown, Navan.*

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Donop, Baron. *Saxe Meiningen.*

Dupin, Charles, Baron. *Paris.*

Ellis, Sir Henry, K.H. F.R.S. Sec. S.A. Librarian of the British Museum.

Forshall, Rev. Josiah, *British Museum.*

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Graham, Robert, M.D. F.R.S.E. Professor of Botany, Edinburgh. *Edinburgh.*

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Hamilton, Francis, M.D.

Harcourt, Rev. William Vernon, M.A. F.R.S. F.G.S. *York.*

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Herschel, Miss Caroline.

Hobhouse, Right Hon. Henry.

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Northampton, Spencer Joshua Alvyne Marquess of, M.A. Pres. R.S. F.G.S. &c. 145, *Piccadilly*, and *Castle Ashby, Northampton.*

Norwich, Right Rev. Edward Stanley, Bishop of, D.D. Pres. L.S. F.G.S. F.Z.S. 38, *Brook-street, London,* and *Norwich.*

Parry, Sir William Edward, Knt. D.C.L. Captain R.N. F.R.S. F.R.A.S. &c. 6, *Devonshire Place, Portland Place, London.*

Phillipart, Sir John.

Prichard, James Cowles, M.D. F.R.S. &c. *Bristol.*

Rafn, C. C. Sec. Royal Society of Northern Antiquaries of Copenhagen. *Copenhagen.*

Rennie, George, Esq. F.R.S. 21, *Whitehall Place, London.*

Schumacher, Heinrich Christian. *Altona.*

Sedwick, Rev. Adam, M.A. F.R.S. V.P.G.S. F.R.A.S. Woodwardian Lecturer, Cambridge. *Cambridge.*

Smyth, William Henry, Esq. Captain R.N. For. Sec. R.A.S. F.S.A. &c. *Bedford.*

Somerville, Mrs. Mary. *Chelsea.*

South, Sir James, Knt. F.R.S. L. & E. F.L.S. F.R.A.S. &c. *Observatory, Camden Hill, Kensington.*

Southey, Robert, LL.D. *Keswick.*

Sussex, His Royal Highness Augustus Frederick Duke of. K.G. F.R.S. F.S.A. &c. *Kensington Palace, London.*

Sykes, Lieut.-Colonel William Henry, F.R.S. F.L.S. F.G.S. F.Z.S. *Albion-street, Hyde-park, London.*

Taylor, Thomas, M.D. *Cork.*

Thomson, Thomas, M.D. F.R.S.L. & E. F.L.S. F.G.S. Regius Professor of Chemistry, Glasgow. *Glasgow.*

Turner, Dawson, Esq. F.R.S. F.S.A. F.L.S. &c. *Yarmouth.*

Walsh, Rev. Robert, LL.D. 53, *Summer Hill.*

Whewell, Rev. William, M.A. F.R.S. Pres. G.S. F.R.A.S. Fellow of Trinity College, Cambridge. *Cambridge.*

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1840. No. 21.

January 27.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

Mr. Otway read a letter from the Rev. J. D'Arcy Sirr, on the ruins of the Abbey of Cong, in the county of Mayo.

Mr. Otway then read the first part of a paper "on the Antiquarian Remains of the North-west of Ireland."

RESOLVED,—(on the recommendation of Council,) that the conditions required previous to the ballot for new Members be all complied with at least one week before such ballot.

RESOLVED,—(on the recommendation of Council,) to insert the words "*ipso facto*," in chap. iv. sect. 3, of By-laws, previous to the words "be excluded the Academy."

DONATIONS.

An ancient Irish Hand-mill, or Quern. Presented by Joseph Huband Smith, Esq.

Theology and Metaphysics of Scripture. By Andrew Carmichael, Esq. Presented by the Author.

February 10.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

Rev. Maurice M'Kay, LL.D., Frederick W. Burton, Esq. R.H.A., Joseph Napier, Esq., and Thomas Hutton, Esq. F.G.S., were elected Members of the Academy.

Resolved,—To empower the Council, to prepare an Address of congratulation to Her Majesty, on the occasion of her marriage, and to affix the seal of the Academy thereto.

The Academy adjourned.

February 24.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

J. Huband Smith, Esq. read a paper "on the different kinds of Querns used by the Irish."

Having lately presented to the Academy, as a contribution to their collection of Irish Antiquities, an oblong quern, or corn-mill, of the most primitive form, Mr. Smith now offered some few remarks on this very ancient article of housewifery.

The circular or rotatory quern, the parent of the modern millstones, is well known to antiquarians; but the still earlier and ruder hand-mill of an oblong form, (and which, therefore, must have been used in a very slow and laborious process, by pushing the upper stone backwards and forwards upon the under,) does not appear to have been hitherto noticed, being, in fact, very rarely met with; while the round quern is of comparatively common occurrence.

The word "quern" comes directly from the Saxon or Teutonic name, with which it is identical. Another simple and domestic machine, the churn, derives its appellation doubtless from the same root; the office of both being to *separate*,—in the one instance, the meal from the husk, and in the other, the butter from the milk. It seems more than probable that the Latin verb "cerno," whose primary meaning is to *separate* or *divide*, took its rise from the operation of these very primitive implements of domestic economy. The approximation in sound will be apparent, if we pronounce the Latin letter *c* hard, as some scholars maintain we should do.

In the Celtic language the quern is denominated "Bró," and in the Welsh or British, "Breyan;" both words having the same origin as the old French verb "Broyer," from which we derive a verb not in very general use, but yet to be found in a work of standard authority, the English translation of the Scriptures, where, as it will be observed, it is met in conjunction with the operation of reducing corn to meal: "Though thou shouldest *bray* a fool in a mortar among wheat with a pestle, yet will not his foolishness depart from him." One very ancient form of quern approaches nearly to the modern mortar, the under stone being a basin supported upon a tripod.

The quern is also called in Irish *cloch-vron*, a term which occurs in the well known Glossary of Cormac Mac Cuillenan, and has been translated to signify "the stone of sorrow," having allusion to the laborious and servile occupation which in ancient times grinding with it was generally esteemed to be. That such, however, was not always the case, appears from an anecdote quoted by Mr. Smith from Professor Tennant, respecting Pittacus, king of Mitylene, one of the seven wise men of Greece, who it seems "had been accustomed in moments of unoccupied languor to resort for amusement to the grinding mill, that being, as he called it, his best gym-

nasium, or pleasantest exercise in smallest space." The memory of this fact is preserved in a song of the Grecian women, called the song of the mill, which began, "Grind mill, grind! even Pittacus, king of Mitylene, doth grind!"

In illustration of the use of the quern at an early period, Mr. Smith cited a notice of it from an ancient Irish poem, (extracted from the Memoir of Londonderry accompanying the Ordnance Survey,) by Cuain O'Lochain, who died, according to the Annals of Tighernach, in 1024: also an interesting Scandinavian legendary ballad, called the Quern song. That Shakspeare was acquainted with it, appears from the allusion in his "Midsummer Night's Dream," where he speaks of the fairy Puck as labouring in the quern.

Mr. Smith then briefly noticed a few of the many passages in Scripture referring to the hand-mill, some of which show it to have been common to the Egyptians and Philistines as well as the Jews. As to its use in modern times in Cyprus, Palestine, Hindostan, and generally throughout the East, he read passages from Shaw's and Clarke's Travels, and from the Journal of Mrs. Farrar, the wife of a missionary at Nassuck near Bombay. He also noticed an engraving in Davis's China, representing a man working a larger mill by means of a sort of handspike which he pushes backwards.

Mr. Smith then read an extract from Pennant's Tour to the Hebrides, referring to the enactment in the reign of Alexander III. of Scotland, (A.D., 1284,) prohibiting the use of the quern except during stress of weather, or in other cases of necessity: notwithstanding which, Pennant still found it there in 1772.

In Sir Walter Scott's visit to the Orkneys in 1814, he saw the quern in the house of an old woman who, practising the trade of a witch, subsisted by "selling winds" to the seamen of the neighbouring coast. And in the Shetland islands

he noticed the rude adaptation of the quern stones to the purposes of a water-mill.

From a curious book, entitled "the Moutgomery Manuscripts," written about 1648, Mr. Smith quoted a description of a similar attempt in the Barony of Ardes, County of Down, in Ireland, to convert a hand-mill into one driven by water, in which "the axle stood upright, and the small stones, or querns, such as are turned with hands, on the top thereof. The water-wheel was fixed at the lower end of the axletree, and did run horizontally among the water, a small force driving it."

In conclusion, Mr. Smith pointed out the progressive improvement in the form of the quern,—from the pair of rude oblong stones, which ground the corn by simple trituration, to the rotatory mortar-shaped quern; thence to the rounded or rather hemispherical form; and concluding with the two flattened stones, similar to those used in the water-mills of the present day.

The Rev. Mr. Todd exhibited to the Meeting a *fac simile* of a remarkable papyrus roll preserved in the British Museum.

The Secretary read the following communication, entitled "Justification of Mrs. Somerville's Experiments upon the magnetizing Power of the more refrangible solar Rays."* By George James Knox, Esq. and the Rev. Thomas Knox.

Professor Morichini of Rome was the first to observe that steel, when exposed to the violet rays of the solar spectrum, becomes magnetic. Similar experiments were tried by Mr. Christie, in 1824; but the most accurate experiments upon this subject have been performed by Mrs. Somerville, in 1825, who determined that not only violet, but indigo, blue and green, develop magnetism in the exposed end of

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* Phil. Trans. vol. cxvi. 1826.

a needle, while yellow, orange, and red, produce no sensible effect. As many philosophers have failed in repeating these experiments, we were induced, in the course of the summer, to undertake the investigation of this subject, "which has so often disturbed science." Having procured several hundred needles, of different lengths and thicknesses, and having ascertained that they were perfectly free from magnetism, we enveloped them in white paper, leaving one of their extreme ends uncovered. Taking advantage of a favourable day for trying experiments upon the chemical ray, (known by the few seconds required to blacken chloride of silver,) we placed the needles at right angles to the magnetic meridian, and exposed them for three hours, from eleven to one, to the differently refrangible rays of the sun, under coloured glasses. Those beneath the red, orange, and yellow, showed no trace of magnetism, while those beneath the blue, green, and violet, exhibited, the two first feeble, but the last strong traces of magnetism.

To determine how far the oxidating power of the violet ray is concerned in the phenomena, we exposed to the different coloured lights needles whose extremities had been previously dipped in nitric acid, and found that they became magnetic (the exposed end having been made a north pole) in a much shorter time than the others, and that this effect was produced in a slight degree, under the red (when exposed a sufficient length of time) strongly under white glass, and so strong under violet glass, that the effect took place even when the needles were placed in such a position along the magnetic meridian, as would tend to produce, by the earth's influence, a south pole in the exposed extremity.

Conceiving that the inactive state produced in iron (as observed by Schœnbein) when plunged into nitric acid, S. G. 1.36, or by being made the positive pole of a battery, or by any other means (which Dr. Faraday supposed to be due to a slight oxide formed on the surface, and which may

be explained by its electrical state by union with oxygen becoming disguised, and rendering it until the oxide be removed incapable of further action) might throw some light upon the nature of the electrical change produced. Experiments were instituted to this effect, which showed that no trace of magnetism could be thereby produced.

The President laid before the Academy some supplementary details connected with his "Researches respecting Vibration."

The President read to the Academy the Address of congratulation to Her Majesty, prepared by Council in pursuance of the resolution of the Academy at its last meeting.

DONATIONS.

Quarterly Journal of the Statistical Society of London. Vol. II. Part 6. Presented by the Society.

Report of the Committee of Commerce and Agriculture of the Royal Asiatic Society. 1839. Presented by the Society.

Transactions of the American Philosophical Society. Vol. VI. Part 3. Presented by the Society.

Proceedings of the American Philosophical Society. Vol. I. No. 8. Presented by the Society.

Reports of the Council of the Literary and Historical Society of Quebec, for 1835 *and* 1839.

Collection de Mémoires et de Relations sur l'Histoire ancienne du Canada d'apres des manuscrits récemment obtenus des Archives et Bureaux Publics en France.

Presented by Robt. Symes, Esq., Secretary of the Society.

The Theory of the Moon. By John W. Lubbock, Esq. V. P. R. S. &c. Presented by the Author.

Flora Batava. No. 118. 5 plates. By Jan Koops. Presented by the Author.

Ordnance Survey of the County of Mayo, in 125 sheets. Presented by His Excellency the Lord Lieutenant.

Barlow's Tables of Squares, &c. published under the Superintendance of the Society for the Diffusion of Useful Knowledge. Presented by the Society.

Supplement to the Introduction to the Atomic Theory. By Charles Daubeny, M.D., F.R.S. Presented by the Author.

March 16. (Stated Meeting.)

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

A letter from the Secretary of State for the Home Department was communicated by his Excellency the Lord Lieutenant, informing his Excellency, that the Address of the President, Council, and Members of the Royal Irish Academy, had been laid before the Queen, and that Her Majesty had received the same very graciously.

The Secretary of Council read the following Report, which was ordered to be entered on the Minutes:

"In resigning their office into the hands of the Academy, the Council have felt it to be their duty, in conformity with the practice of other kindred societies, to present a brief Report of their Proceedings, and of the general history of the Academy during the past year.

"The Council regret to state that the financial condition of the Academy has not been an improving one. They believe, however, that this circumstance (though it must create the necessity for circumspection) will not be regarded as discouraging, when it is known to have arisen from a cause essentially connected with the welfare and vitality of the Society. The character of an association formed for the advancement of any branch of learning, must be

judged of by its fruits, and these fruits are, in an eminent and especial manner, its published memoirs. It is by its Transactions that it will be estimated beyond the walls of its assembly-room; and whatever may be, in other respects, the instruction or the entertainment derived from its meetings, its Memoirs can alone be taken to mark its actual progress, and define the limits of its conquests in the wide region of the unknown. When, therefore, your Council state, that it is this very progress which has pressed upon the funds of the Academy, they believe that it will be granted, that the circumstance is one rather for congratulation than regret.

"The chief source of the expenditure of the Academy is that arising from the printing of their Transactions. Within the last few years, however, the papers read to the Academy, and offered for publication, have greatly increased in number, as well as value; and, accordingly, the rate of publication of the Transactions, and the attending expenses, have increased in the same proportion. This rate, in fact, has of late years much more than doubled; and the expenses of printing and engraving have, of course, proportionably augmented.

"The Council have great pleasure in stating, that the publication of the Proceedings of the Academy, at brief intervals, under the superintendance of the Committee of Publication, has been productive of great benefit to the interests of the Academy, by giving an early publicity to the results of their labours. They are happy to add, that the new postage regulations have enabled them to send these Proceedings to all the Societies in Britain with whom they are in correspondence, as well as to all the non-resident members.

"In connexion with the subject of publication, the Council think it right to mention the steps which have been taken in regard to the publication of Mr. Petrie's Essay on the Round Towers of Ireland. The appearance of this essay having been delayed for many years, and being earnestly desired by the members of the Academy, the Council felt that it was incumbent upon them to hasten it as far as lay in their power. As a preliminary step, a skilful London artist, Mr. Branston, was brought over to execute the wood-cuts, Mr. Petrie having agreed, on his part, to make the drawings himself

upon the wood. Notwithstanding the saving of expense thus attained, the cost of this part of the work (owing to the large number of illustrations necessary) was considerable, being estimated at between £300 and £400. The current income not being sufficient to bear the weight of this charge, the Council applied to the Academy, and on the 24th of June last, the Academy authorized the Treasurer to sell stock to the amount of £400.

"Since that time the engravings have been proceeded with, and part of the sum voted has been already paid. The Committee of Publication have recently received the assurances of the author, that the manuscript will be shortly ready for the printer. The essay, when printed, will occupy an entire volume of the Transactions; and, from the expectations which have been raised respecting the work, there can be no doubt that the sale will defray a portion, at least, of the expense incurred.

"To replace the stock above alluded to, as well as to guard against a progressive diminution of the annual income of the Academy from the practice of compounding for life, the Council would suggest, for the consideration of the Council of the ensuing year, the expediency of investing, in future, the proceeds of the life subscriptions in the Government funds.

"The following are the names of the members which the Academy has lost by death within the last year:

The Earl of Caledon.
John Oldham, Esq.
William Morrison, Esq.

"The following are the names of the new members added to the body since the 16th of March, 1839:

John U. Owen, M. D.
Thomas Rhodes, Esq.
Edward Conroy, Esq.
Nicholas P. Leader, Esq.
William R. Wilde, Esq.
Alexander Parker, Esq.
Jonathan Osborne, M. D.
William Longfield, Esq.
William Hill, Esq.
John A. Bowles, Esq.
Sir Philip Crampton, Bart.
William J. Lloyd, Esq.
John Mollan, M. D.
Frederick Burton, Esq.
Joseph Napier, Esq.
Thomas Hutton, Esq.
Rev. Maurice M'Kay.

"The subject of members in arrear has come under the consideration of the Council, and, in pursuance of the measures adopted by the Council of the preceding year, they have recommended to the Academy a slight alteration in the By-laws relating to defaulters, the operation of which will be, that, henceforward, there will be no members more than two years in arrear, such persons ceasing, *ipso facto,* to be members of the Academy. This modification of the By-law (which is in conformity with the spirit of the original) has been adopted by the Academy; and it will have the effect of removing an apparent opposition between their rules and usages, besides tending to insure, in future, greater regularity of payment.

"Some objection having been raised to the course recently adopted by the Academy in reference to the election of new members, the Council have prepared an enlarged formula of certificate for candidates, which, it is hoped, will remove all difficulties, and, at the same time, convey the required information with regard to the eligibility of the candidate.

"It has also been recommended by the Council, and resolved by the Academy, that the conditions required previous to the ballot for new members, be all complied with at least one week before such ballot.

"A charter-book, with the usual obligation engrossed, has been prepared to receive the signatures of new members on admission. The Council request that members, who have already signed in another roll, will write their names also in this book, so as to render it, as far as possible, a complete record of the history of the Academy.

"The miscellaneous property of the Academy consists of their library (including their collection of MSS.) and their (as yet) small collection of antiquities.

"On the subject of the library the Council have to state, that a Book Committee was appointed at the commencement of the year, to examine the state of the library generally, and to report thereon to the Council. The additions made to the library, during the past year, have been confined chiefly to the regular periodicals. The collection of MSS. has been enriched by a copy of the Book

of Lismore, which was lent by his Grace the Duke of Devonshire, and transcribed at the expense of the Academy.

"The Council have the pleasure of stating, that the task of forming a perfect catalogue of the library has been nearly completed by the Assistant Librarian, Mr. Clibborn; and they gladly avail themselves of this opportunity to express their sense of the value of the services which that gentleman has rendered to the Academy during this, the first year of his office.

"The Societies whose Transactions enrich the library of the Academy are:

The Royal Academy of Sciences, Berlin.
The Royal Academy of Sciences, Brussels.
The Royal Society of Sciences, Copenhagen.
The Physical and Natural History Society of Geneva.
The Royal Academy of Sciences, Lisbon.
The Royal Academy of History, Madrid.
The Italian Society of Sciences, Modena.
The Royal Academy of Sciences, Paris.
The Imperial Academy of Sciences, St. Petersburgh.
The American Philosophical Society, Philadelphia.
The Royal Academy of Sciences, Turin.
The Royal Society of London.
The Royal Society of Literature, London.
The Royal Society of Antiquaries, London.
The Royal Astronomical Society of London.
The Geological Society of London.
The Royal Society of Edinburgh.
The Linnæan Society.
The Cambridge Philosophical Society.
The Manchester Philosophical Society.
The Asiatic Society of Calcutta.

"In addition to this list, the Council have, during the past year, negotiated an interchange of Transactions with the Geological Society of France; the School of Mines of Paris; the Zoological Society of London; and the Institution of Civil Engineers.

"The Academy having purchased, in the year 1837, a small collection of antiquities, belonging to Mr. Underwood, the attention of Council was directed to their arrangement; and, on the 22nd of April last, the sum of £50 was placed at their disposal by the Academy, for the erection of convenient cases for their reception. This collection has since received two additions of great historical interest and high value, namely,—the Cross of Cong, presented by Professor Mac Cullagh, and two gold Torques, discovered at Tara, presented by a number of gentlemen who subscribed liberally for their purchase. The Council trust that others will be induced to follow the example set by these public-spirited individuals, and will contribute to the formation of a collection illustrative of the national antiquities, the study of which it is one of the main objects of the Academy to foster and promote.

"The medal for the best essay in Polite Literature and Antiquities, communicated during the three years preceding the 1st of January, 1839, has been awarded by the Council (as the members of the Academy are already aware) to Mr. Petrie, for his paper on the Antiquities of Tara Hill.

"The Council of the ensuing year will have to consider for medals, the papers in Mathematics (pure and applied,) and in Polite Literature, which have been communicated during the three years previous to the 1st of January, 1840."

The Auditors appointed by Council to examine the Treasurer's Accounts reported as follows:

"We have examined the above Account,* with the vouchers produced, and have found it to be correct; and we find that there is a balance in bank of £150; and in the Treasurer's hands of £62 8*s*., making a total balance of £212 8*s*. sterling.

"(Signed,)

"Franc Sadleir.

"Samuel Litton."

"*March* 14, 1840."

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* Entered in the Treasurer's Book.

"The Treasurer reports that there is £1384 6*s*. in 3 per Cent. Consols, and £1500 in 3½ per Cent. Government Stock, to the credit of the Academy in the Bank of Ireland; the latter being the Cunningham Fund.

"(Signed,)

"THOMAS HERBERT ORPEN."

"*March* 14, 1840."

The ballot having closed, the President requested the Provost and Dr. Litton to assist the Officers in examining the balloting lists.

The Scrutineers reported that the following Gentlemen were duly elected Officers and Council for the ensuing year:

President—Sir William Rowan Hamilton, LL. D.

Treasurer—Thomas Herbert Orpen, M. D.

Secretary to the Academy—Rev. Joseph H. Singer, D.D.

Secretary to the Council—James Mac Cullagh, LL. D.

Secretary of Foreign Correspondence—Rev. Humphrey Lloyd, A. M.

Librarian—Rev. William Hamilton Drummond, D. D.

Clerk and Assistant Librarian—Edward Clibborn.

Committee of Science.

Rev. Franc Sadleir, D. D., Provost of Trinity College; Rev. Humphrey Lloyd, A. M.; James Apjohn, M. D.; James Mac Cullagh, LL. D.; Rev. William Digby Sadleir, A. M.; Robert Ball, Esq.; Robert Kane, M. D.

Committee of Polite Literature.

His Grace the Archbishop of Dublin; Rev. Joseph Henderson Singer, D. D.; Samuel Litton, M. D.; Rev. William Hamilton Drummond, D. D.; Rev. Charles Richard Elrington, D. D.; Rev. Charles William Wall, D.D.; Rev. Thomas H. Porter, D. D.

Committee of Antiquities.

Thomas Herbert Orpen, M. D.; George Petrie, Esq. R. H. A.; Rev. Cæsar Otway; Very Rev. the Dean of St. Patrick's; Rev. James Henthorn Todd, D. D.; Henry J. Monck Mason, LL. D.; Aquilla Smith, M. D.

The President then appointed, under his hand and seal, the following Vice-Presidents:

His Grace the Archbishop of Dublin; the Provost of Trinity College; the Rev. Humphrey Lloyd; the Very Rev. the Dean of St. Patrick's.

DONATIONS.

Philosophical Transactions for 1839. Parts 1 and 2.

Proceedings of the Royal Society. Nos. 37, 38, 39, and 40.

Catalogue of the Scientific Books in the Library of the Royal Society.

Fellows of the Royal Society. Nov. 1839.

List of the various Councils of the Royal Society from 1800 *to* 1839.

Presented by the Society.

Mecanique Celeste. Translated by Dr. Bowditch. Vol. IV. Presented by the Translator's Children.

Transactions of the Cambridge Philosophical Society. Vol. VII. Part 1. Presented by the Society.

Memorie della Societa Italiana delle Scienze. Tome XXII. Parte Matematica. Presented by the Society.

Premier Memoire sur les Kaolins ou Argiles a Porcelaine. Par M. Brongniart. Presented by the Author.

Memoires de la Societe de Physique et d'Histoire Naturelle de Geneve. Tome VIII. 2me Partie. Presented by the Society.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Premier Semestre, 1840. Nos. 1—5. Presented by the Academy.

A few Notes on the History of the Discovery of the Composition of Water. By J. O. Halliwell, Esq.

A Catalogue of the Miscellaneous Manuscripts preserved in the Library of the Royal Society. By J. O. Halliwell, Esq.

Presented by the Author.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

	1840.	No. 22.

April 13.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

Samuel Hanna, M. D., William Torrens M'Cullagh, Esq., George M'Dowell, Esq., F. T. C., John Ball, Esq., Rev. Dr. Traill, Robert Alexander Wallace, Esq., and Thomas Newenham, Esq., were elected Members of the Academy.

Dr. Apjohn, on the part of Surgeon Grimshaw, drew the attention of the Academy to a modification of the air-thermometer recently devised by the latter gentleman. The well-known objection to the ordinary air-thermometer he stated to be, that the air within the ball being in communication (through the interposed column of fluid) with the external air, its volume comes to be affected not merely by changes in the temperature of the surrounding medium, but by the perpetually occurring variations in the atmospheric pressure. In fact, to render its indications truly thermometric, they must be reduced by calculation to a constant pressure, reference being made in every observation to a correct barometer. Nor did Sir John Leslie, in his differential thermometer, get rid of this difficulty. It is true that all con-

nexion of the air within the instrument with the external atmosphere is cut off; but when one of the balls is heated, and the elasticity of the air within it thus augmented, and the intervening column of fluid driven towards the cool ball, the elasticity of the air within the latter is also obviously increased by compression. Equal increments of temperature cannot, therefore, produce equal augmentations of volume, and, when the stem of such an instrument is divided into parts of equal capacity, the corresponding temperatures constitute, not an arithmetical series, but one which increases much more quickly. In fact, if t be the temperature, v the volume of the air in the heated ball, and v' the volume of air in the cool ball, t varies not as v, but as $\frac{v}{v'}$.

This source of embarrassment in the air thermometer Mr. Grimshaw removes by a contrivance, a notion of which may be simply conveyed by describing his instrument as a differential thermometer, in the cool ball of which is placed a barometer, while to the side of the same ball a little syringe is attached, by means of which air may be pumped in or out, and the elasticity of the included air thus rendered invariably the same, before the temperature (exhibited upon the scale of equal parts attached to the stem in connexion with the hot ball) is registered. Two forms of this instrument were placed on the table of the Academy, which, however, Dr. Apjohn stated should be considered rather as rough models, than as finished instruments. Dr. Apjohn observed, that Mr. Grimshaw intended attaching to his thermometer a provision for keeping the barometer vertical; and marking upon this latter instrument two additional points of constant pressure,—one higher, the other lower, than the atmospheric standard,—by the use of which, when necessary, the scale of the instrument may be greatly extended, so as to comprehend with ease the entire of the atmospheric range of temperature.

Dr. Apjohn read a paper on the subject of an essential oil not long since observed during the rectification of common whiskey. This substance he received in December, 1838, from Mr. Scanlan, who had it from Mr. Bowerbank, an eminent London rectifier. Shortly previous to this time, it was observed by Mr. Eneas Coffey, the inventor of the celebrated patent still, in the faint receiver at the extensive distillery of Sir Felix Booth; and Mr. Scanlan himself, upon coming over to Dublin, and visiting the establishment of Mr. Busby, at Blackpitts, recognized this same oil precisely where it was observed by Mr. Coffey, namely, in the vessel into which the weak spirit which comes over towards the close of the distillation is conducted.

Dr. Apjohn stated in detail the properties of this fluid, and the experiments which he made with the view of determining its composition. It was burned in the usual way with oxide of copper, and gave, as the means of three separate experiments, the following results:—

Carbon.	68.13
Hydrogen . . .	13.33
Oxygen	18.54
	100

The most simple formula corresponding nearly with these results is $C_5 H_6 O$, and it was therefore that which he adopted. Assuming it as the true one, the composition of the oil would be,—

Carbon.	68.60
Hydrogen . . .	13.45
Oxygen	17.95
	100

The deficiency in the carbon, experimentally determined, is not greater than what usually takes place. But the error

in the hydrogen, though trifling in amount, being upon the opposite side to that on which it usually occurs, it became expedient to resort to some method of verification. The specific gravity of the vapour of the oil was therefore taken by the well known method of Dumas, and found to be 3.137: the formula $C_5 H_6 O$ would make it 3.072. But there is here so close a correspondence between experiment and calculation, that no doubt can remain as to the correctness of the basis on which the latter rests, or that the formula already arrived at represents correctly the constitution of the oil.

These experiments were made in the winter of 1839, and Dr. Apjohn stated that he was then under the impression that the oil in question was a new substance, or rather one which had not been previously described. Some months after, however, upon looking over the second part of Professor Graham's Elements of Chemistry, he was surprised to find (in a table of the volumes of atoms in the gaseous state,) mention made of a substance under the designation of "oil of the ardent spirits from potatoes," to which was attributed the very same formula, and density of vapour, which he had found to belong to the oil of *corn* whiskey, given him by Mr. Scanlan. Anxious to investigate the matter further, and to ascertain whether the two oils were certainly the same, Dr. Apjohn looked into Dr. Thomson's fifth volume on Organic Chemistry, and found there (page 481) a notice of the potato oil, with a reference to the 30th and 56th volumes of the Annales de Chimie, in the former of which its origin and properties are described by Pelletan, and in the latter of which its analysis is given by Dumas. Upon perusing these papers, his suspicions as to the identity of the two oils were confirmed. In composition and properties they are the same· the only difference being, that Pelletan represents the potato oil as having the specific gravity .821, whereas Dr. Apjohn found that of the corn oil but .813,—a

difference, however, easily explained by the circumstance of the former chemist not having taken the necessary steps for purifying perfectly the liquid he examined.

As a very unusual coincidence it may be observed, that the specific gravity of the vapour of potato oil, as obtained by Dumas, is 3.147, or but unity in the second place of decimals greater than has resulted for the corn spirit oil from Dr. Apjohn's experiments. The oil therefore of Pelletan and Dumas is not, as is generally supposed, peculiar to potato spirit, but occurs also in that developed by the fermentation of the cerealia. From this latter source also it admits of being obtained in great quantity. When first observed by Mr. Coffey at Sir Felix Booth's, there was an inch of it in the faint receiver; and from the diameter of this vessel he estimated its total amount to be at least fifty gallons. This is the quantity produced at that establishment every fortnight, the excise laws compelling the distiller to distil and brew alternately, and about a week being consumed in each process.

The whiskey manufactured some years ago contained, Dr. Apjohn observed, a considerable quantity of this oil, and owed to its presence a great deal of the pungency of taste and smell by which it was distinguished. From the nature of the still at present generally used, but a small portion of this substance passes over; and hence the reason why the spirit now made is, as compared with the product of the old processes, less disagreeable to the palate, and probably less injurious to the constitution. It is undoubtedly owing to the same cause, (an improvement in the process of distillation,) that this oil has at length been noticed in the distillers' faints. Upon the old system of manufacture the greater portion of it was driven over, and was held dissolved by the spirit into which it was thus introduced; but with the modern stills, particularly that devised by Mr. Coffey, nothing having so high a boiling point as this oil, can by pos-

sibility pass into the part of the apparatus where the spirit is condensed.

Dr. Apjohn proceeded to observe, that the potato spirit oil, as it has been hitherto called, has of late attracted much of the attention of chemists. Pelletan, from some rough experiments upon it with acids, threw out the idea that it was more analogous to alcohol than to the volatile oils, and this opinion seems to have been in some measure adopted by Dumas. More recently M. Auguste Cahours (Annales de Chimie, January, 1839) has revived this opinion, and concluded it to be one of the groups including alcohol, pyroxilic spirit, and acetone. He represents it by the formula $C_{10} H_{12} O_2 = C_{10} H_{10} + 2 H O$, which obviously makes it quite analogous to alcohol in composition. The carbo-hydrogen $C_{10} H_{10}$ he has insulated, by distilling the oil from anhydrous phosphoric acid. He calls it *amilene*, and finds the specific gravity of its vapour to be 4.904, so that an atom of it gives but one volume of vapour,—a circumstance in which, as Cahours observes, it agrees with Dr. Kane's mesitylene, but differs from the carbo-hydrogens $C_4 H_4$ and $C_2 H_2$ which occur in alcohol and pyroxilic spirit. By acting upon potato spirit oil, (or, as Cahours calls it, amilic alcohol,) with sulphuric acid and chlorine, he obtained products corresponding perfectly with those yielded by ordinary alcohol when similarly treated. The amilic ether, or $C_{10} H_{10} + H O$, he did not succeed in insulating.

Dr. Apjohn observed, in conclusion, that he had been aware, for more than twelve months, of the identity of the fluid oil which he had examined with the potato spirit oil of the French chemists; but having engaged in the examination of another oil, of the consistence of butter at ordinary temperatures, which is well known to exist in corn spirit, it was his intention, when he had completed his experiments upon it, to give publicity to what he knew of both oils in the *same* paper. In the mean time, however, Liebig and Pelouze

published their memoir (Annales de Chimie et de Physique, tom. 63, p. 113,) upon an oleaginous matter, which comes over during the distillation of wine, towards the close of the process, and which they showed to be a mixture of what they denominated œnanthic acid with œnanthic ether. Having perused this paper, Dr. Apjohn felt satisfied, from the progress he had already made in the investigation, that the buttery matter found in small quantity in ordinary whiskey, and to a much greater amount in the distillers' faints, was in a great measure the same with the substance which the chemists just named had found to come over during the distillation of wine in the production of brandy. A third oil, however, different from the œnanthic acid and œnanthic ether, he soon found to be present; and while occupied in examining it, his attention was directed by Dr. Kane to the 2nd part of Poggendorf's Annalen for 1837, which contained a paper on the subject of these products, by a German chemist named Mulder. In this paper it is satisfactorily shown that the solid oil of malt and corn spirit is a mixture of the oil of wine of Liebig and Pelouze, with a third substance, which he called *oleum siticum*. Being thus clearly anticipated as respected the solid oil, Dr. Apjohn observed that he had no motive for further delay; and he accordingly submitted to the Academy the facts from which he was enabled to conclude that the fluid oil (or amilic alcohol of Cahours) is not, as is generally thought, peculiar to potato spirit, but occurs also in that which is manufactured in this country by the fermentation of a mixture of malted and unmalted grain.

DONATIONS.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Premier Semestre, 1840. Nos. 6—12. Presented by the Academy.

Proceedings of the Numismatic Society of London, 1837-38. Presented by the Society.

The New County Book of Tipperary. By Jeffries Kingsley, Esq., M. R. I. A. Presented by the Author.

An Essay on the Mineral Structure of the South of Ireland. By Thomas Weaver, Esq., M. R. I. A. &c. Presented by the Author.

A Letter to the President of the Royal Irish Academy. By Sir William Betham, M. R. I. A., &c. Presented by the Author.

An Essay on the Heat of Vapours and on Astronomical Refractions. By John William Lubbock, Esq. Presented by the Author.

Greenwich Observations for 1838. Presented by the Astronomical Society.

Bulletins de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles, année 1839. (Nos. 5 and 6.) Presented by the Academy.

Annuaire de l'Academie Royale des Sciences et Belles-Lettres de Bruxelles, pour les Années 1839-40. Par le Directeur A. Quetelet. Presented by the Author.

Notice sur Martin van Marum. Par A. Quetelet. Presented by the Author.

De la Liberté Physique et Morale. Par L. A. Gruyer.

Examen critique d'un Mémoire de M. P. Leroux, intitulé, Du Bonheur. Par L. A. Gruyer.

Presented by the Author.

FOR THE YEAR ENDING MARCH 31st, ...

THE CHARGE.

	£ s. d.	£ s. d.
Balance in favour of the Academy, April 1st, 1839		130 11 9
Parliamentary Grant, Session 1839	300 0 0	
Treasury warrants for Rent and Taxes	146 17 8	
		446 17 8
Transactions sold	4 19 0	
Mr. Boone, London Bookseller, do.	11 19 0	
Hodges and Smith	3 5 8	
		20 3 8
£115 14s. 0d. Consols sold at 91⅝	106 0 0	
39 15 10 do. do. 91⅝	36 4 0	
		142 4 0
One year's interest on £1500, 3½ Government Stock	52 10 0	
One half do. do. 3 per Cent. consols	22 10 0	
Half year's do. on £1384 6s.	20 15 4	
		95 15 4
One year's rent of stable		21 0 0
Subscriptions, Life Compositions	207 18 0	
Entrance	84 0 0	
Annual, and Arrears	277 4 0	
		569 2 0
Total.		£1425 14 5

THE DISCHARGE.

	£ s. d.	£ s. d.
House, Coals, Candles, &c,	45 17 6	
Repairs of House, Furniture, &c.	135 3 9	
Rent, Taxes, and Insurance	149 10 11	
		330 12 2
Salaries, Servants' Wages, &c.		250 13 6
Books, per Hodges and Smith	68 19 10	
Taylor's Scientific Memoirs	12 0 0	
Sharpe,	1 5 6	
Fegan	0 14 6	
Oriental Translation Fund subscription, 2 years	21 0 0	
Pollen, subscription to Lives of distinguished Irishmen	0 16 6	
A Directory	0 4 0	
		105 0 4
Bookbinding.—Mullen		151 8 10
Transcribing.—Address to Queen, per Smith	5 5 0	
Book of Lismore, Curry	10 0 0	
Comparing do. O'Donovan	8 8 0	
		23 13 0
Printing.—Graisberry	176 2 4	
Morrison (Lithography)	1 4 0	
Johnston, advertising	4 3 0	
		181 9 4
Engraving.—Branston	142 4 0	
Kirkwood	23 5 6	
Duncan	47 10 0	
Waller	1 12 6	
		214 12 0
Stationery.—Hope	5 6 6	
Perry,	0 15 6	
		6 2 0
Cunningham Medals		19 19 4
Contingencies		68 0 2
Total Discharge		1351 10 8
Balance in favour of the Academy		74 3 9
Total		1425 14 5

STATE OF THE BALANCE.

In Bank of Ireland, as per Certificate	£50 10 0
In Treasurer's hands	23 13 9
Balance as above	£74 3 9

April 13th, 1840. *Signed*, THOMAS HERBERT ORPEN, *Treasurer*.

April 27.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

His Grace the Archbishop of Dublin gave a verbal account of some observations which he had made upon the weather, in connexion with the prognostic drawn from the variations of atmospheric pressure, as indicated by the barometer. The sudden changes of the barometer, his Grace observed, were well known to be connected with corresponding changes of the weather as to rain or drought, and the great and rapid falls with the sudden approach of a gale of wind; but it did not seem to be so generally remarked, that the *slow* and *continuous* changes of the height of the mercury in the barometer were likewise indications of the approach of a season of *long continued* wet or dryness. It was to some connexions of this latter kind, noticed by himself, that he now drew the attention of the Academy. The first of these occurred in the early part of the summer of 1818, when, from the slow and gradual rise of the barometer for the space of ten days, he was led to predict the approach of a long continued dry season. The drought which followed was one of the most remarkable that had occurred in this climate for many years. The second instance of the same kind observed by his Grace was in the early part of the spring of the present year. On the 17th of February the barometer commenced to rise, but very slowly, and the rise continued for six or seven days; he was thus led to expect a long continuance of dry weather; and the result, as is well known, fully verified the anticipation, the change being followed by more than three weeks, during which there was not a single drop of rain, and that too at a season of the year usually wet.

The Secretary read a notice by Mr. George Knox on the

subject of the Contact Theory of Electricity, as connected with the views suggested in his paper "on the Direction and mode of Propagation of the Electric Force, in media not undergoing Electrolyzation." Mr. Knox referred, at some length, to the recent experiments of M. Peclet on this subject, published in the *Annales de Chimie.*

The Secretary read some memoranda of the native Indian account of Tabasheer, communicated by William Farran, Esq.

The Secretary read the continuation of a paper by James Orchard Halliwell, Esq., F.R.S., F.S.A., &c. &c, on the Boetian numerical Notation.

I.

An Inquiry into the Period of the first Use of the Zero by those Writers who adopted the Notation of the Boetian numerical Contractions.

During the researches made by M. Chasles, of Chartres, and myself, on the subject of the Boetian numerical contractions,—the former published in the Transactions of the Brussels Academy, and the *Comptes Rendus* of the Academy of Sciences, the latter in an Appendix to the *Rara Mathematica,* —we came to no definite conclusion on the nature of the change from the use of the abacus to that of local position and the cipher. Some documents recently discovered by me have strikingly elucidated this point of the inquiry, and as they develop an entire new view of a system before only conjectural, I have ventured to place the results before the notice of the Royal Irish Academy, the more especially as the general objects of that body render the subject more appropriate to their views than those of any society in England.

Before I enter into this short discussion, to give the reader an idea of the state the subject was left in, I will quote my latest opinion:—

"It would be impossible, with the few materials yet brought to light, to conjecture with any great probability how far these Boetian contractions may have influenced the introduction, or cooperated with the Arabic system to the formation of our present numerical notation. It appears to me highly probable that the two systems became united, because the middle age forms of the figure *five* coincide with the Boetian mark for the same numeral, and those of two others are very similar. The idea of local position, again, may have had an independent European origin; the inconveniences of the abacus on paper would have suggested it by destroying the distinguishing boundaries, and inventing an arbitrary hieroglyphic for the representation of an empty square."—*Rara Mathematica*, p. 111.

Now, from the Mentz MS. in the Arundel Collection, it is very evident that their mode of operation with the abacus had received one great improvement on the Greek and Roman system, the abolishing the necessity of motion, and only using the table *cum pulvere*, as a means for distinguishing position. Thus, in the following addition sum, using the names instead of the cabalistic characters, we have an example of their method of proceeding:—

Andras	Igin	Calcis	Andras
Tenis	Arbas	Ormis	Celentis
Celentis	Calcis		Igin

Thus making a total of— celentis, calcis, zero, igin. Now, it is evident, that in order to do away with the necessity of this table, supposing the contractive marks again substituted for the latter words, we have only to imagine an arbitrary character for the deficiency under the *ormis*, and the *modus operandi* is synonymous with our own present form.

The following are new instances of the appearance of the zero without its use:—

MS. Hatton. 7, we find the following passage:—"inscribitur et in ultimo figura 0, sipos nomine. Quæ licet numerum nullum significet: tum ad alia quædam utilis est."

MS. Lansd. 842, is a contractive mark for a sipos, outside the drawing of the abacus.

MS. Hatton. 112. The sipos is given with its contraction, but is only used to fill up the space in the abacus.

Now, at the last page of a very beautiful MS. of the translation of Euclid, by Athelard, of the fourteenth century, and in the *explicit* of the fifteen books, the number 15 is written in these singular contractions, and without a division. This MS. is in the Arundel Collection of MSS., and was accidentally discovered by me when looking into it for another purpose.

The new face thus put upon the question of their gradual identity with the present system, and the satisfactory evidence that the latter portion of my former conjecture is correct, is sufficient almost to make me bold enough to venture on the truth of the previous one. It must be recollected, however, that on the last point one document only has yet been discovered.

II.

The middle-age Knowledge of the Alabaldine Notation considered as an Argument in Favour of the early Introduction of the Boetian Zero into Western Europe.

I beg leave to make the following additional observations in corroboration of what was stated by me on the same subject in a paper read before the Academy on the 13th of January.

The recent dispute* between M. Chasles and M. Libri,

* An account of the whole discussion may be found in the *Comptes Rendus Hebdomadaires* of the Academy of Sciences, for the 7th and 14th of October last, pp. 447-454, and pp. 463-472.

before the French Institute, relative to the bearing of certain points in my Essay on the Boetian contractions, has not established a single important fact, save that the knowledge of local value was apparent in the *integral* abacal operations of these contractions. On the question of the period of the introduction of the Boetian zero, confessedly the most curious and difficult point to be established, none of the continental writers, M. Chasles, M. Libri, or M. Vincent, have ventured on more than random conjectures.

The Boetian fractional notation, or the Alabaldine notation,* was first explained in the above-mentioned Essay, previously to which no rational conjectures respecting them had been made. I am now enabled to prove that this notation was not only recognized, but commonly employed throughout the middle ages.

A passage at the end of the second book of "Boetii Geometria," *de minutiis*,† proves that the system was contemporary with that writer. Bede, in his Treatise on Arithmetic, has given a whole chapter to it. Next comes the Arundel MS.‡ of the twelfth century, from which I am enabled to give a most exceedingly curious specimen of their *modus operandi*:—

QUESTION.§ It is required to multiply *semis* $\left(\frac{1}{12}\right)$ into *siliqua* $\left(\frac{1}{144}\right)$: What is the result?

SOLUTION. *Semis* = *as* . *semiuncia*, but *as* = *igin*; therefore, *semis* = *igin* . *semiuncia* = *semiuncia*; because *igin* is the Boetian unity.

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* So called from its presumed inventor.

† MS. Lansd. 842, B. &c. ‡ No. 343, in the British Museum.

§ It is almost unnecessary to observe that this is much simplified and abridged from the MS.

Now $scrupulus = \frac{calcis}{calcis} . scrupulus;$ because $\frac{calcis}{calcis} = igin$

$\therefore scrupulus = calcis . \frac{scrupulus}{calcis}.$

But $\frac{scrupulus}{calcis} = siliqua \therefore scrupulus = calcis . siliqua.$

and $semis . siliqua = semis . \frac{scrupulus}{calcis} = semiuncia . \frac{scrupulus}{calcis}$

$= semiuncia . \frac{igin}{calcis} . scrupulus.$

But, by the integral notation, $\frac{igin}{calcis} = \frac{andras . igin}{andras . calcis} =$

$\frac{igin}{andras} . \frac{andras}{calcis} = \frac{igin}{andras} . \frac{igin}{ormis} = semiuncia . duella.$

Therefore,

$semis . siliqua = semiuncia . semiuncia . duella . scrupulus.$

We have now to reduce the

$semiuncia . semiuncia = \frac{igin}{andras} . \frac{igin}{andras} = \frac{igin}{arbas} = sicilius.$

and, $semis . siliqua = sicilius . duella . scrupulus.$

We have thus the required quantity in a very complicated form. To effect the reduction of this is the work of another long operation, which it is unnecessary to repeat here, as the above will sufficiently serve for an example of the laborious, though ingenious, plan which was pursued.

Gerbert, in his Treatise on Geometry,* makes use of this notation, and adds, *quod abacistæ facillimum est.*† The MS. Burney, 213, in the British Museum contains an express treatise on it. Added to which, the Alabaldine contractions are constantly occurring in mathematical manuscripts, and till very lately no one had the slightest idea of their true nature.

* Pezri Thesaurus, t. i. p. ii. col. 13. † Ib. col. 30.

That the writers on the Boetian contractions could have accomplished the solution of intricate fractional questions (entirely dependent on the principl^ of local position) without the knowledge of the zero, or some arbitrary character to express its situation, appears to me to be quite impossible. Above all, it must be remembered that the abacus was *not* employed with the Alabaldine notation.

A paper was read by William R. Wilde, Esq., on the animal remains and antiquities recently found at Dunshaughlin, in the county of Meath.

Surgeon Wilde prefaced his observations by stating, that the communication which he was about to make, on the subject of the vast collection of bones which were recently discovered in the county of Meath, was but introductory to a more detailed description of their zoological and anatomical characters which he purposed bringing before the Academy at a future meeting. But, having had several opportunities of visiting the spot where these remains were found, and having collected some information upon the subject from the persons who superintended, and others who were actually engaged in making the excavations, he felt it necessary to lay before the Academy a popular description of the place,—in order to show under what circumstances these bones were found, and to enable the members present to form some idea as to the nature of this very remarkable collection. In addition to this statement of facts, he would likewise exhibit several of the antiquities found in connexion with the animal remains, in the hope that the antiquary and the historian might, from their examination, be enabled to arrive at some probable conclusion as to the date of the construction of this place.

The following is an extract of Mr. Wilde's statement: "About a mile to the east of the village of Dunshaughlin,

on the townland of *Lagore*, and near the margin of a 'cut-away' black bog, is a circular mound, slightly raised above the surrounding plain, its highest central part being about eight feet above the margin, and the circumference of the mound measuring 520 feet. A small stream passes through this circle; and the whole bog in which it is situate occupies a slight concavity of about a mile and half in circumference, bounded by raised tillage and pasture lands. Within the memory of some of the old inhabitants of the neighbourhood, this bog was covered with water during the greater part of the year, and it is so invariably during winter, up to the present period. A large pond is still in existence in one of the fields adjoining the mound. (Mr. Wilde exhibited a map of the mound and the surrounding country.) A few years ago, some labourers, while clearing the stream-way, discovered several bones protruding from its sides; and in May, 1839, the quantity of bones found in the drain was so great, and their value so well known, that a further examination was made, when it was discovered that the greater part of the mound was composed of the remains of animals, placed there in the following manner:

"The circumference of the circle was formed by upright posts of black oak, measuring from six to eight feet in height; these were morticed into beams of a similar material, laid flat upon the marl and sand beneath the bog, and nearly sixteen feet below the present surface. The upright posts were held together by connecting cross beams, and fastened by large iron nails; parts of a second upper tier of posts were likewise found, resting on the lower ones. The space thus inclosed was divided into separate compartments, by septa or divisions that intersected one another in different directions; these were also formed of oaken beams, in a state of great preservation, but joined together with greater accuracy than the former, and in some cases having their sides grooved or *rabitted* to admit large pannels driven

down between them. The interior of the chambers so formed were filled with bones, and black moory earth, and the heap of bones was raised up in some places within a foot of the surface. It was generally found that the remains of each species of animal were placed in separate divisions, with but little intermixture with any other; and the antiquities, &c., were found along with them, without any order or regularity, but for the most part near the bottom."

The most numerous class of bones were those of oxen, and of these Mr. Wilde exhibited the heads of several varieties, in a state of great perfection. Some of these were identical with those which formed the subject of Mr. Ball's communication to the Academy, in January, 1839, and which were discovered in the bogs of Westmeath, Tyrone, and Longford; others bore a strong resemblance to them.

There were other specimens of these oxen which, although of rather diminutive size, equalled, as to beauty of head and horn, the modern improved breed of the English short-horned Durham, and the middle horned Devon and Ayreshire,—being distinguished by the peculiarities of the head, and in particular of the *slug* or core on which the horn is moulded, and which had remained quite perfect, although the cuticular horn had been destroyed.

A fourth variety was that which has been denominated the true Irish cattle,—the long-horned, or crumple-horned, the improved large breed of which still exists in some of the midland counties of Ireland, particularly Roscommon. In this variety there is a very remarkable projection of the upper portion of the frontal bone between the horns, which latter turned downwards, and a little backwards, somewhat in the manner of the Craven or Lancashire stock.

There were also several heads of the *polled* or hornless variety, called in this country *mhaol*, exhibiting some slight differences as to the fineness of their heads, but in general resembling the Galloway and Angus breeds.

All these heads differ from those figured in Cuvier's *Ossemens Fossiles;* and Mr. Wilde regretted that he was at present unable to draw the necessary comparisons between the existing breeds and those found at Dunshaughlin, from the want of a collection of the heads of the former in the museums of this country, and from our not possessing any work having accurate plates of the anatomical characters of the horned cattle, although it is upon such characters that the zoologist and the cattle-breeder found their distinctions. A great number of these heads are broken in the centre of the forehead, as if by some blunt instrument—apparently the mode of slaughter. It might naturally be expected that the best breeds and the largest assemblage of these animals should be found (even at an early period) upon the fertile and extensive plains of Meath; and the whole collection offers an incontestible proof, that at a remote period Ireland possessed not only *several varieties* of horned cattle, but also breeds analogous to those most valued in England at the present day, and lately re-introduced into this country.

The animal, whose remains were found in the greatest abundance next to the ox, was the pig—several of the heads of which were produced, of all ages and sizes, but of a smaller description than those at present bred in this country.

There were one or two specimens of the horse and ass. The bones of a number of deer were likewise found in the collection, both male and female. The former, some of the antlers of which are quite perfect, prove the race to have been the common deer; and in no instance were the horns of the Fallow deer found—verifying the general opinion of naturalists, that the latter are an introduced race into this country. Large quantities of the bones of goats of all ages were dug up. The head of a *four-horned* sheep was also discovered in the same locality, of a peculiar form, to be described hereafter; this was the only instance of the sheep that Mr. Wilde had been able to procure.

Some of the most remarkable remains found in this inclosure were those of a very large and powerful dog, apparently belonging to an animal of the *grey-hound* tribe, but of enormous size—the heads measuring, in the dry bone, nearly eleven inches in length, and principally characterized by the great extent and magnitude of the occipital crest, and the projecting muzzle. Mr. Wilde stated it as his opinion, that we had now, for the first time, an opportunity of judging of the form and characters of the dogs denominated *Irish wolf dogs*, to which breed he considered these heads to have belonged. There were also several foxes, but no wolves. With these remains were mixed up the shells of limpids and buccinums; and a few bones of birds; some portions of *burned* bones, and large quantities of hazel nuts. Most of the bones of the larger ruminants were unbroken; and upwards of 150 cart-loads of bones have been already dug out of this inclosure, and have been forwarded to Scotland for manure, none of them being in a fossil state.

Nearly in the centre of the heap, and within two feet of the surface, were discovered two human skeletons, lying at length, and without any surrounding wood or stone work, &c. The superstitions of the people who were employed in making the excavation, led them to re-deposit 'them in the neighbourhood, and they cannot now be obtained; but Mr. Wilde produced some of the vertebræ, and the frontal bone of one of these bodies, and remarked upon the similarity of the latter to other heads found in ancient Irish monuments, and in particular its striking analogy to those found in the Cromleigh recently opened in the Phœnix-park.

The antiquities found in this place may be divided into the warlike, the culinary, and the ornamental. They consisted of *iron* swords of different lengths, with straight edges and angular points, and bearing a resemblance to the ancient Roman swords. Very many knives were found, of different shapes and sizes, with iron spear, javelin, and dagger blades,

and part of the boss or central ornament of a shield; but *no brazen weapons* of any description. Two querns, or ancient corn mills, were found on the marl, at the bottom of the inclosure; sharpening stones; iron chains; an iron ax; a brazen pot, and three small brass bowls of most elegant shape and workmanship; several articles precisely resembling miniature frying pans, of about three inches in diameter (perhaps incense burners); circular discs of turned bone, wood, and slate, like those supposed to have been used at the end of the distaff; small shears, like the modern sheep shears; brazen, bone, and iron pins, from four to six inches in length—the former of great beauty of construction; brooches, and parts of buckles, containing pieces of enamel and mosaic work; bracelets; wooden (yew tree) combs, tooth-picks, etwees, and other articles belonging to the toilette. Several of these articles show an extraordinary state of perfection of the arts at the period of their construction.

A very curious bone was likewise found, and exhibited to the meeting, with a number of devices carved on it, as if by way of practice in engraving; these devices consisted of scrolls and marks precisely similar to those formed on ancient Irish crosses, ornaments, and grave-stones. There were no crosses, beads, or *Christian* sacred ornaments found in the excavation; but a number of pieces of stags' horns sawn across, and also pieces of hazel wood, in great quantity, as if laid up for fire-wood, were found in one spot near the bottom.

On the surface of the mound, but apparently without any connexion with it, a groat of Robert the Second, of Scotland, was picked up.

Some of the articles exhibited now belong to the collection of the Dean of St. Patrick's; but the greater number were forwarded for the inspection of the Academy, by Mr. Barnwall, of Grennanstown, on whose ground the discovery was made, and to whom Mr. Wilde was indebted for the bones, and permission to make any researches he might require.

Mr. Wilde concluded by impressing on the Academy the importance of appointing persons to inquire into this and such other objects of antiquarian interest as might, from time to time, come to their knowledge, and thereby preserving them to the Academy and to science; and he read a letter from Mr. Barnwall, offering every facility to the Academy, or to any of its members, to make further investigations into the bone-heap at Lagore.

The thanks of the Academy were voted to Mr. Barnwall, for his obliging offer.

It was Resolved, (on the recommendation of Council,) to omit the words in Chapter II. Sect. 5, of By-laws, following the words "each candidate proposed."

DONATIONS.

A Spear Head. Presented by Sir W. Betham.

An Examination of the Ancient Orthography of the Jews, and of the original State of the Text of the Hebrew Bible. By Charles W. Wall, D.D., M.R.I.A. Presented by the Author.

Ordnance Map of the County of Wicklow, in Forty-nine sheets, including Title and Index. Presented by His Excellency the Lord Lieutenant.

Burgh Records of the City of Glasgow. By John Smith, Esq. Presented by the Author.

Journal of the Franklin Institute. Vol. XXIV. for 1839. Presented by the Society.

Proceedings of the American Philosophical Society, Vol. I. Nos. 9 and 10. Presented by the Society.

Quarterly Journal of the Statistical Society of London, Vol. III. Part 7. Presented by the Society.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1840. No. 23.

May 11.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

John Davidson, Esq., James Henry Blake, Esq., Q.C., and Abraham Abell, Esq., were elected Members of the Academy.

A paper was read by Jonathan Osborne, M.D., on Aristotle's History of Animals :

Dr. Osborne commenced by observing, that this work was composed under circumstances more favourable to the acquisition of natural knowledge than any work on the subject ever published. According to Pliny, some thousands of men were placed at the disposal of the author, throughout Greece and Asia,—comprising persons connected with hunting and fishing, or who had the care of cattle, fish ponds, or apiaries,—in order that he might obtain information from all these quarters, *ne quid usquam gentium ignoraretur ab eo.* And according to Athenæus, the same prince gave him, on account of the expenses incurred in composing it, 800 talents,—a sum, which taken at the lowest, that is, the lesser

Attic talent, amounts to above £79,000. The work composed under such auspices, is such as might have been expected. The extent of the observations is prodigious; and we cannot read far in any part of it, without being constrained to exclaim with Cicero, *Quis omnium doctior, quis acutior, quis in rebus vel inveniendis vel judicandis acrior Aristotele?*

Shortly after the introduction of Greek literature to Europe, and when this book was first printed, those sciences which have nature for their object, were in the lowest condition. There was at that time no taste diffused for the study of zoology or comparative anatomy; and at later periods, when the value of these studies came to be better appreciated, the Aristotelian philosophy had fallen into disuse. Thus this work has, from this combination of circumstances, been passed over; is seldom quoted except at second-hand; and no edition of it distinct from the other works of the author, or illustrated as the subject required, has appeared since that of Scaliger, published in 1619,—except one, accompanied by a French translation by Camus, in 1782, which is said to be incorrect, and is become scarce.

Dr. Osborne proceeded to make a short analysis of the contents of this work, and showed that Aristotle had anticipated Dr. Jenner's researches respecting the cuckoo, as also some discoveries with respect to the incubated egg, which have been published within the last year. His observations on fish and cetaceous animals are curious in the extreme, as might be expected from the variety of these animals abounding in the Grecian seas. Those on insects it is difficult to appreciate, from uncertainty as to the names. He describes the economy of bees, as we have it at present; but mistakes the sex of the queen. He holds the doctrine of spontaneous generation in those cases, in which he could not detect the ovary; an inevitable conclusion arising from the want of the microscope, to which, and the want of knowledge of pneumatic chemistry, his principal errors are to be referred.

The various organs are described as modified throughout the different classes of animals, (beginning with Man, the Βουλευτικον μονον) in nearly the same order as that afterwards adopted by Cuvier.

As specimens of the interesting matter treated of in the work, Dr. Osborne selected the animal nature of sponges; the ages of various animals; the movements of the nautilus, (the same doubt existing in the author's mind as to the origin of the shell, which has divided the opinions of Messrs. Blainville, Owen, Gray, and Mad. Power, within the last year;) the localities of animals, as affording data for ascertaining the rate at which they have extended themselves over the globe; particulars relating to artificial incubation as practiced in Egypt; the management of cattle; a mode of fattening hogs with rapidity, by commencing with a fast of three days; the mohair goat located in Cilicia, as at present; hybernation and migrations of various animals and fish; description of the fisher-fish (lophius piscatorius,) and of the torpedo, with the proof that they catch their prey in the extraordinary manner described; many ingenious modes of taking partridge, and of fishing detailed; the friendships which have been perpetuated between different classes of animals,—as the trochilus and the crocodile, the pinna muricata and the cancer pinnotheres, the crow and the heron; their animosities, as between the crow and owl; the diseases of animals traced throughout the series, extending even to fish; hydrophobia described, as being communicated by the bite of the rabid dog to all animals except man, which appears to be the correct statement with respect to hot climates, and not (as has been represented by some modern travellers,) an entire absence of the disease.

These detached specimens of the contents of this work furnish, however, a very inadequate idea of its real value. There are in it whole sections, the separate sentences of which,

would furnish texts for as many Bridgewater Treatises. The freshness and originality of the observations taken from nature herself, and not made up from quotations of preceding writers; the extent of the views, not bounded by any necessity for complying with preconceived or prevalent notions, but capacious as the author's mind itself, and frequently leading the reader into the most interesting under-currents of thought branching off from the great fountain; these are all merits belonging to the work, but not constituting its chief value,—which is, that it is a collection of facts, observed under peculiar advantages, such as have never since occurred, and *that it is at the present day to be consulted for new discoveries*.

Now that Greece is, for the first time since the revival of letters, in possession of a government capable of appreciating scientific investigations, a favourable opportunity offers for preparing an edition of the work, at once worthy of the age in which it was composed, and of that in which we live; and perhaps some individual may be found, possessing a competent knowledge of the Greek language, and of zoology and comparative anatomy, who, after a sufficient examination of the animals now in Greece, shall undertake the task of editing and illustrating this great work. Such a performance, properly executed, would be the resuscitation of a body of knowledge, which has lain buried for above 2000 years; and would certainly be no less acceptable to zoologists and anatomists than to the cultivators of classical learning.

The Rev. Dr. Todd exhibited to the Academy a gold ring, the property of William Farren, Esq., which was received in barter, from the natives of the western coast of Africa. The similarity of the twist in this ring to that of the gold torques found at Tara, and recently presented to the Academy, renders it extremely worthy of attention. The following extract of a letter from Mr. Weston, of Lon-

don, by whom the gold ring was presented to Mr. Farren, and which is addressed to that gentleman, was read to the meeting:—

London, March 31*st*, 1840.

"In reference to the African gold, or torque as you call it, a young correspondent of mine, resident at Sierra-Leone, and a merchant there, happens to be at this time in London; from him and his father I have received many boxes of this pure gold, and he has furnished me with his own information upon the subject, which I send you inclosed; he tells me there are large rings or torques, full the size of those I saw in the library of the Royal Irish Academy. Recollect the inclosed is written by a man of colour, and an African by birth, educated in England under my care, and now a resident in his own country. By this you will see what some of these men are capable of.

"I have written to Africa, and desired a large ring may be procured for you; I have no doubt this discovery may throw some new light, as to the existence of a connexion in early days between Africa and Ireland."

The following is the letter from the African gentleman alluded to by Mr. Weston:—

"31*st March*, 1840.

"My dear Sir,

"In answer to your inquiries relative to the gold rings that are generally sent from Sierra-Leone, I must first candidly explain that what little information I may be able to afford, has been derived from the gold strangers or traders that visit the colony, and not from any personal intimacy with the places where the gold is procured.

"The gold out of which these rings are *twisted*, is found in the countries of Seral-Doolley, Timbuctoo, Seran-Colley, Follah, Bondou, Kasson, Kaarta, Bambarra, and Timbo, all of which tribes are distant about 1400 miles from, (in latitude 15° N.) and visit Sierra-Leone, in hoards of from two to four and five hundred at a

time, travelling generally on foot; these journeys take them from two to four months, and equally long to return to their homes. They are all of the Mahomedan persuasion, and proficient Arabic scholars. Their manners are easy and insinuating; and in conversation, which is always (or generally) done through an interpreter, they are full of compliments and flattery. Agreeably to the Mahomedan creed, they use no liquor, wine, or beer of any kind, (not even ginger beer,) and drink exclusively water, or sugar and water. They are, for the most part, very uncleanly in their habits, and particularly so in their dress—oftentimes wearing one apparel without ever taking it off to cleanse their bodies the whole time they are away from home; their clothes are consequently almost in rags before they put on new ones.

"The gold is found in veins, and dug up in a solid substance, resembling the fine roots of trees. It is then purified by a mere melting process, in crucibles, so as to separate the earthy portion from the metal itself. The Africans are not capable of amalgamating the gold, this is left for the refiners in England to do.

"In some of the countries already mentioned,—Bondou and Timbo, more particularly,—they sweep out their huts every morning, the floors of which are mud; and no person is permitted to stir out until this office is performed. In the dust they sweep up, a little gold is mixed. They then wash the whole in vessels for the purpose, and the gold naturally sinking to the bottom, is thus separated, and obtained in small quantities. The twisting is accomplished by holding both ends of a solid piece of gold between nippers, and then turning it round until it assumes the appearance in which it is imported, being exceedingly ductile; this is not a tedious process. The rings thus twisted, are sometimes from *twelve* to *fifteen inches* in circumference, and weighing about *fourteen ounces*. I however have heard, that they are made much longer and heavier; but these are not, to my knowledge, parted with in the way of trade, but worn as ornaments round the neck and arms.

"In the interior, all transactions are carried on for gold, the trader being furnished with a pair of scales made of the hard outer skin of the orange gourd. The weights are the seeds of certain vegetables or fruits. They thus pay in gold from *two pence* to £10, and

upwards. This I have often seen, and proved their exactness by weighing the same pieces in English scales.

"Gold is also found in Central Nigritia, and on the Guinea coast; this I believe is principally in dust, and obtained by the same method of washing.

"I have seen a piece of gold in its natural rough state; it was a solid piece, about five inches long, and of the thickness of a common writing quill. It was smooth in appearance, but seemingly composed of a number of layers, compressed together by a natural mechanical force, with veins like the grain of wood from the root of a tree.

"In the countries I have here alluded to, the natives cultivate farms, but in a very careless and rough manner, merely cutting down the trees, but never rooting up the stumps or clearing away the smaller plants, but plant the rice or cassava negligently among the whole of this stubble, waiting till the rice, &c. may grow, to distinguish one from the other. They never sow or make use of the same farm a second time; but the soil is excessively sterile and sandy. Domestic poultry is plentiful; also sheep, and other horned cattle. They take great care of their cows, milk forming a principal luxury in their daily diet.

"The gold strangers invariably visit Sierra-Leone, accompanied by several slaves, who bring ivory and other articles for barter. They all represent the countries from which they come, as possessing plenty of gold, but no facilities for procuring it.

"Salt is considered a great luxury in the interior of Africa, and eagerly sought after in trading.

"I remain, my dear Sir,

"Yours, assuredly,

"W. Gabbidon."

The Rev. H. Lloyd, V.P., read the following communication by Dr. Apjohn, on the value of the numerical coefficient, in the formula for the force of aqueous vapour in the atmosphere, as derived from the observations of the wet and dry thermometers.

"If t and t' be the temperatures shown by a dry and wet thermometer, encompassed by atmospherical air, t'' the dew-point, f' and f'' the forces of aqueous vapour at t' and t'', and p the existing pressure,—I have shown (Trans. R. I. Academy, vol. xvii., p. 285,) that

$$f'' = f' - \frac{t-t'}{87} \times \frac{p-f'}{30}.$$

"In investigating this expression, it is assumed that the specific heat of air, and the caloric of elasticity of aqueous vapour, are constant, and represented (within the ordinary variations of atmospheric temperature and pressure,) the former by .267, the latter by 1115. In subsequently applying this expression to the determination of the specific heats of the gases, (Trans. R. I. Academy, vol. xviii.) it was necessary to give it its most general form, when it was found to become

$$f'' = f' - \frac{48\, a\, (t-t')}{e} \times \frac{p-f'}{30};$$

a being the specific heat of air, and e the latent heat of aqueous vapour, both being supposed at the temperature represented by t', and under the pressure p. I shall here briefly indicate the steps which conduct to this result. They are given at length in the Philosophical Magazine, for October, 1838.

"The two following propositions constitute the basis of the investigation:

"1st. When, in the case of the wet thermometer, the stationary temperature is attained, the caloric which vaporizes the water, is necessarily equal to that which the surrounding gas evolves in descending through $t - t'$ degrees, *i. e.* from the proper temperature of the air to that of the moistened bulb.

"2dly. The air so cooled, by successive contacts with the moistened bulb, is saturated with humidity.

"From these propositions we easily deduce the equation

$$f'' = f'\left(1 - \frac{m'}{m}\right) \qquad (I)$$

in which m' represents the amount of vapour formed by the caloric extricated from a given volume of air, in cooling through $t - t'$ degrees; and m the maximum amount of vapour, which the same volume of air could contain at t'. In this expression f' may be considered as known, the corresponding temperature t' being the result of observation. In order, therefore, to render the formula available, it is only necessary to determine in known terms the values of m' and m.

"If a be the specific heat of air, and e the caloric of elasticity of aqueous vapour at the temperature t', it is easy to see that $\frac{e}{a}$ grains of air, in cooling through $t - t'$ degrees, evolve sufficient heat to vaporize exactly $t - t'$ grains of moisture. For m', therefore, in the formula just given, $t - t'$ may be substituted. Again, m may obviously be replaced by the maximum amount of moisture capable of being contained in $\frac{e}{a}$ grains of air at the temperature t' and pressure p. But to obtain this, it is only necessary to reduce $\frac{e}{a}$ grains of air to cubic inches; to multiply the resulting volume by $\frac{p}{p - f'}$,* in order to get the expansive effect of moisture; and finally multiply the volume thus obtained by the weight of a single cubic inch of aqueous vapour. When this is done, we find $m = {\cdot}625 \times \frac{e}{a} \times \frac{f'}{p - f'}$. Reverting now to equa-

* In the investigation given in the Philosophical Magazine, this step is omitted. The omission, however, does not sensibly affect the accuracy of the resulting formula.

tion (I), and writing in it the values just found for m' and m, we arrive at the final equation

$$f'' = f' - \frac{48\,a\,(t - t')}{e} \times \frac{p - f'}{30}, \qquad \text{(II)}$$

in which the force of vapour at the dew-point is expressed in terms of the force of vapour at t', and of the difference of the temperatures of the wet and dry thermometers.

"This formula is applicable for all values of t' above 32°; but when the stationary temperature of the wet thermometer is lower than the freezing point, it will require modification. $\frac{e}{a}$ grains of air, we have seen, in cooling through $t - t'$ degrees, convert into vapour $t - t'$ grains of moisture. But if t' be less than 32°, a greater amount of air will be necessary for accomplishing this, inasmuch as the heat evolved has first to liquify ice, and then to convert the water into vapour. The additional quantity is obviously represented by the fraction $\frac{135}{1179 - t'}$; 135 being the caloric of liquidity of water, and $1179 - t'$ the latent heat of aqueous vapour at t'. But this fraction, if we substitute 32° for t', (which may be always done without sensible error) is equal to 0·118. Hence for values of t' below 32°, $\frac{e}{a} + 0{\cdot}118\,\frac{e}{a} = 1{\cdot}118\,\frac{e}{a}$ is, in grains, the weight of air which, in cooling through $t - t'$ degrees, vaporizes $t - t'$ grains of moisture. When this correction is applied, the final equation, applicable to observations in which the wet thermometer indicates lower temperatures than 32°, becomes

$$f'' = f' - \frac{43\,a\,(t - t')}{e} \times \frac{p - f'}{30} \qquad \text{(III)}$$

"Assuming, as before, the specific heat of air, a, to be ·267, the value assigned to it by Delaroche and Berard, and taking for e the value it would have at 50°, upon the hypothesis that 967° is the latent heat of vapour at 212°, and

that the sum of its sensible and latent heat is at every temperature a constant quantity,—equation (II) becomes

$$f'' = f' - \cdot 01135\,(t - t') \times \frac{p - f'}{30}\,; \qquad \text{(IV)}$$

and equation (III) becomes

$$f'' = f' - \cdot 01017\,(t - t') \times \frac{p - f'}{30}\,. \qquad \text{(V)}$$

"The theory which has led to these conclusions is now universally admitted to be correct; but as doubts may be entertained respecting the exactness of the coefficient, whose value, as has been seen, depends on the numbers by which a and e are represented, (numbers which are, in all probability, not as yet known with great precision,) it would appear desirable to deduce its value directly from experiment. This is the immediate object of the present communication.

"In my second paper on the dew-point, I have given three distinct series of experiments, applicable to such a purpose;—the first relating to air whose dew-point was determined by Daniell's instrument; the second to air perfectly dry; and the third to air whose dew-point is known with certainty, and without the aid of any form of condensation hygrometer. From these, in all of which t' is greater than 32°, I have calculated 54 values of the coefficient, by methods to the explanation of which I now proceed.

"1. Representing the coefficient in question by m, the hygrometric formula becomes

$$f'' = f' - m\,(t - t') \times \frac{p - f'}{30}\,.$$

Now if air, in reference to which t and t' have been accurately noted, be raised to any higher temperature, and the observation repeated, we obtain data for determining the value of m. For f'' being constant, $f' - m\,(t - t') \times \frac{p - f'}{30}$, for one observation, will be equal to $F' - m\,(T - T') \times \frac{P - F'}{30}$

for another, from which we deduce

$$m = \frac{(F' - f')\,30}{(T - T')(P - F') - (t - t')(p - f')}.$$

"The subjoined tables contain the experiments; and applying to them the method of calculation just explained, we obtain eleven values of m.

SERIES 1.

TABLE 1.

No.	t	t'	$t - t'$	p
1	49·6	44·7	4·9	29·6
2	88·5	62	26·5	29·6
3	80·5	59	21·5	29·6

1 & 2 . $m =$ ·0118
1 & 3 ...... ·0121
2 & 3 ...... ·0110

TABLE 2.

No.	t	t'	$t - t'$	p
1	47·2	42·5	4·7	30·02
2	76	57·5	18·5	30·02

1 & 2 . $m =$ ·0144

TABLE 3.

No.	t	t'	$t - t'$	p
1	48·3	43	5·3	29·76
2	96	64	32	29·76
3	91	62·5	28·5	29·76
4	75	56	18	29·76

1 & 2 . $m =$ ·0117
1 & 3 ...... ·0122
1 & 4 ...... ·0132
2 & 3 ...... ·0035
2 & 4 ...... ·0103
3 & 4 ...... ·0109

TABLE 4.

No.	t	t'	$t - t'$	p
1	51·3	45·5	5·8	30·7
2	82	59	23	30·7

1 & 2 . $m =$ ·0106

Mean value of $m =$ ·01151

"2. In the general formula given above, if $f'' = 0$, $m = \frac{f'}{t - t'} \times \frac{30}{p - f'}$. My observations of t and t' in dry

air, which I here subjoin, enabled me, by means of this expression, to calculate 19 additional values of m.

SERIES 2.

No.	t	t'	$t-t'$	p	m
1	51	33·5	17·5	30·55	·0122
2	53	34·5	18·5	30·35	·0116
3	52	34	18	30·21	·0118
4	51	33	18	30·05	·0115
5	52	33·4	18·6	29·75	·0108
6	53	34·3	18·7	29·50	·0118
7	56·5	35·8	20·7	29·70	·0112
8	58	37	21	29·72	·0110
9	58·2	37	21·2	29·77	·0113
10	58	37	21	30·03	·0114
11	58	37	21	30·15	·0113
12	59	37·5	21·5	30·25	·0112
13	59	38	21	30·26	·0117
14	61	38·7	22·3	30·21	·0113
15	58·3	37·7	20·6	30·35	·0117
16	58	37·5	20·5	30·45	·0117
17	56·3	36·5	19·8	30·30	·0117
18	57·5	37	20·5	30·20	·0116
19	57·5	37	20·5	30·15	·0116
				Mean. =	·01150

"3. Lastly, if in the formula f'' and f' be known, so also is m, for it is obviously equal to $\frac{f'-f''}{t-t'} \times \frac{30}{p-f'}$. But in the case of air saturated with humidity, by being passed through water, its temperature is its dew-point; so that this latter is easily and certainly known. Hence, if the temperature of such air be raised, and a wet and dry thermometer be observed in it, we have t, t' and t''; and can therefore, by the expression just given, calculate the value of m. The following table includes 24 distinct observations, from which the values of the coefficient given in the last column have been thus deduced:

SERIES 3.

No.	t	t'	$t - t'$	p	t''	m
1	78	62·2	15·8	30·30	51·3	·0110
2	76	61·5	14·5	30·30	51·3	·0111
3	73	60·3	12·7	30·30	51·3	·0108
4	72	60	12	30·30	51·3	·0118
5	69	58·6	10·4	30·30	51·3	·0106
6	90·5	67	23·5	30·15	50·8	·0119
7	82·2	64·3	17·9	30·15	50·9	·0123
8	79	82	17	30·15	50·9	·0110
9	71·7	60	11·7	30·15	51·2	·0116
10	69	58·9	10·1	30·15	51·5	·0112
11	92	69	23	30·42	51·1	·0120
12	83	65·8	17·2	30·42	54·5	·0116
13	76	63·3	12·7	30·42	54·9	·0113
14	68	60·3	7·7	30·42	55	·0112
15	98·5	71·5	27	30·36	55·5	·0117
16	84·6	67	17·6	30·36	56	·0115
17	77·5	64·5	13	30·36	56·3	·0112
18	81	62·2	8·8	30·36	56·5	·0111
19	83	66·5	16·5	30·51	56·8	·0108
20	77	65	12·	30·51	57·2	·0117
21	71·3	63	8·3	30·51	57·5	·0116
22	91·8	68·6	23·2	30·51	54·1	·0115
23	75·2	63·2	12	30·51	55	·0116
24	72	62·	10	30·51	55·1	·0115
					Mean =	·01140

"The following, therefore, are the means deducible from each separate series of observations:

Series 1 . . . $m =$ ·01151
Series 2 . . . . . . ·01150
Series 3 . . . . . . ·01140

So that the mean of all three is $\cdot 01147 = \frac{1}{87 \cdot 18}$, or almost exactly the coefficient which I have given in my papers on the dew-point."

Mr. Lloyd then proceeded to offer some remarks upon Dr. Apjohn's communication, and upon the most probable value of the coefficient to be derived from his results.

We have here, he said, the results of three distinct series of experiments, conducted upon *different principles*, and by *different processes;* and, as we observe, the mean values of the coefficient thus deduced present the most complete agreement, the greatest difference amounting only to ·00011. It is almost indifferent under these circumstances, which of these results be adopted; but in order to do complete justice to the subject, we shall here investigate the *most probable* value of the final mean, as given by the calculus of probabilities.

In order to do this, it is necessary to deduce, in the first instance, the *probable error* of each mean, as derived from the results of its own series. This error, it is well known, is expressed by the formula

$$\text{E} = \frac{\cdot 455\, \Sigma\, (x-a)^2}{n\,(n-1)},$$

in which $\Sigma\,(x-a)^2$ denotes the sum of the squares of the differences of each partial result and the mean, and n the number of observations. The results of this calculation are given in the last column of the annexed Table.

Series.	n	m	E
1	11	·01151	·00031
2	19	·01150	·00005
3	24	·01140	·00006

The most probable value of the final mean, will now be given by the formula

$$m = \frac{\frac{m_1}{\text{E}_1^2} + \frac{m_2}{\text{E}_2^2} + \frac{m_3}{\text{E}_3^2}}{\frac{1}{\text{E}_1^2} + \frac{1}{\text{E}_2^2} + \frac{1}{\text{E}_3^2}};$$

from which we find $m = \cdot 01145$.

In the preceding deduction we have supposed that the only errors to which the separate values of m are liable are the errors of observation, in which case the *positive* and

negative errors would be equally probable. But there is another class of errors involved, belonging to the Tables of the elastic force of vapour at different temperatures. In fact, the value of m being expressed in terms of f, and f being calculated from the *observed* value of t, by these Tables, it is obvious that the errors of the Tables will affect the result. In this point of view, however, there is a very important difference between the second series of experiments and the other two. The values of m, in the first and third series, are expressed in terms of the *difference of two values of f;* so that any *constant* error, in the Tables which give the values of f, must wholly disappear in the result; and any error nearly constant must, for the same reason, be nearly evanescent. The case is different, however, in the second series. Here m is expressed in terms of a single value of f; and the tabular error of that value has therefore its full effect. Now, that the errors of the Tables are of the kind alluded to,—i. e. nearly constant within certain moderate limits of temperature,—will be evident from the mode in which they are constructed. The value of f is in all cases calculated from an empirical formula, which (within the ordinary range of temperature) does not vary rapidly with moderate changes of t; the error in the value of f, therefore, (i. e. the difference between its value as calculated with the *assumed* and with the *true* formula,) may, therefore, be regarded as nearly the same, for a moderate range of the variable on which it depends.

It follows from this, that, in the second series, the true probable error is greater than that deduced from the observations themselves, and is the *resultant* of that error and of the error of the Tables. If this latter error were known *à priori*, the resultant error could be inferred; but as this is not the case, we have no means of knowing the *weight* due to the result of that series, and have, therefore, no rule to guide us in combining that result with the other two.

We are thus compelled in strictness to omit that result altogether in deducing the final mean. Combining, therefore, the results of the first and third series, according to the method already laid down, we have

$$m = .01140\ ;$$

a result which is identical with that of the third series, that of the first, (on account of its large probable error) not affecting the fifth place of decimals.*

But the second series of experiments, though it cannot properly be combined with the others in deducing the mean, may yet serve another purpose. It may be made, in fact, a test of the accuracy of the different tables of the elastic force of vapour, within the range of temperature belonging to the experiments. With this view, the values of the coefficient, m, have been calculated by Dr. Apjohn from his second series of experiments, by means of three separate tables of the elastic force of vapour. The first of these tables is that which has been employed above, as well as in his papers on the Wet Bulb Hygrometer in the Transactions of the Academy, and is that calculated by Dr. Anderson from the experiments of Dalton and Ure. The second table is that deduced by Mr. Kämtz, from his own experiments; and the third is that given in the Report of the Committee of Physics and Meteorology of the Royal Society, and calculated by Mr. Lubbock from a formula of his own. The results are given in the annexed table.

* The errors of observation in the first series, which are so considerable in comparison with those of the other two, are manifestly owing to the mode of observing f''. For it is obvious that the rapidly varying temperature of the thermometer in the condensation hygrometer cannot be noted at a precise instant, with the same certainty as that of a thermometer which has arrived at a stationary temperature.

No.	Anderson.	Kämtz.	Lubbock.
1	·0122	·0108	·0110
2	·0116	·0107	·0109
3	·0118	·0107	·0110
4	·0115	·0104	·0107
5	·0108	·0104	·0107
6	·0118	·0107	·0110
7	·0112	·0102	·0105
8	·0110	·0105	·0108
9	·0113	·0104	·0107
10	·0114	·0104	·0107
11	·0113	·0104	·0107
12	·0112	·0103	·0107
13	·0117	·0107	·0111
14	·0113	·0104	·0107
15	·0117	·0108	·0110
16	·0117	·0107	·0110
17	·0117	·0108	·0111
18	·0116	·0106	·0109
19	·0116	·0107	·0109
Mean =	·01150	·01055	·01084

It will be remarked at once, on the inspection of these numbers, that the differences of the corresponding results for the *same experiment*, as well as those of the means, are considerably greater than those of *different* results, as calculated by the *same table:* plainly proving that the error due to the imperfection of the tables is greater than the error arising from observation. If we now take the differences between the *mean* values of *m* according to each table, and the final mean already obtained, we find that the error in the value of *m* deduced from the first table is only + .00010. The same error, in the case of the second table, is — .00085; and in that of the third, — .00056. The *probable difference*, supposing the partial means to be affected only by the errors of observation, is less than .00008. We have reason to conclude, therefore, that the second and third of these tables are not so correct as the first—at least for temperatures corresponding to those of the thermometer

with the wettened bulb in these experiments; and that the values which they give for the elastic force of vapour, for these temperatures, are too low.

(*Additional Note by Dr. Apjohn.*)

"M. Kupffer has recently been engaged in discussing the value of m, the coefficient in the hygrometric formula. In a note read by him at the Petersburgh Academy, on the 22nd of last January, and published in the *Bulletin Scientifique*, No. 132, after a detailed examination of the experiments of August, Gay-Lussac, Erman, Bohnenberger, and Kämtz, he comes to the conclusion, that the theoretic value of m, or $\frac{48\,a}{e}$, agrees sufficiently well with that deduced from the most trust-worthy comparative observations on the dew-point. The formula which he definitively adopts, is

$$f'' = f' - \cdot 267\,(t - t')\,;$$

f' and f'' being expressed in tenths of an English inch, and t and t' in degrees of Reaumur's thermometer. But this, expressing f' and f'' in inches, and t and t' in degrees of Fahrenheit's scale, becomes

$$f'' = f' - \cdot 01142\,(t - t')\,;$$

an expression in which the coefficient is almost identical with that which has been deduced above from the three series of experiments to which I have so often referred. This formula, however, M. Kupffer observes, gives results in accordance with direct observation, only when the table of the elastic force of vapour drawn up by Kämtz is employed; from which he infers, that *it* alone represents with accuracy the relation between the tension and the temperature of steam—an opinion from which, notwithstanding the high authority of M. Kupffer, I am compelled to differ, on the grounds already stated by Professor Lloyd.

"There is another statement of less importance made by

M. Kupffer, to which also I find it impossible to assent. He alleges that the dew-point obtained directly by Daniell's hygrometer is always lower than the truth; and he ascribes this to the bad conducting power of glass, by reason of which the opposite surfaces of the ball containing the thermometer will, while refrigeration is proceeding, have different temperatures, so that when the outer surface has a dew deposited on it, the temperature of the inner surface, and that of the ether in contact with it, are sensibly lower. I do not deny that, theoretically speaking, this must be the case; but I certainly doubt much whether the cause assigned can produce any appreciable effect of the kind attributed to it. On the contrary, according to my experience, the observed is *almost invariably higher* than the true dew-point. Such must inevitably be the case when the ether is poured on too rapidly; for we have thus a local reduction of temperature at the surface of the ether in the ball containing the thermometer, considerably greater than that indicated by the instrument, as *it* merely shows the mean temperature of the entire column of fluid in which its bulb is immersed. In fact, I have frequently observed, under such circumstances, a ring of dew to be formed, for example, at 44°, and to disappear subsequently, though the temperature of the inner thermometer was kept steadily at this point, or even carried lower,—showing clearly that partial deposition may take place before the true dew-point is attained. The only mode of avoiding this is to pour on the ether very slowly, so as to produce such a gradual lowering of the included thermometer, that the entire of the ether in which it is immersed shall have, at each instant, a temperature which may be considered uniform throughout. As another cause why the observed dew-point is higher than the true, I may mention the augmentation of the humidity of the air in the vicinity of the instrument, by the pulmonary halitus and cutaneous perspiration of the observer; a cause which must

be admitted to exercise a sensible influence, when it is considered how close the observer must be to the instrument, and what a considerable length of time is generally necessary for an observation.

"While upon this subject I may observe that Professor Daniell's rule,—to take as the dew-point the *arithmetic mean* between the temperatures indicated by the included thermometer, at the moment of the *deposition* of the ring of moisture, and at the instant of its *disappearance*, appears to me to be erroneous. I have just assigned the reasons which induce me to conclude that the former temperature is (at least in most instances) above the truth; and it is obvious that the latter must always be on the *same side*, for evaporation cannot commence until the temperature of the ball reaches the point of deposition, and will therefore not be completed until it has actually got above this point. The observed results, therefore, being both above the true dew-point, so also will be the mean itself.

"There is one other topic, suggested by a perusal of M. Kupffer's note, to which I am anxious to advert. Upon ordinary occasions the dew-point formula may be used without the factor $\frac{p-f'}{30}$, by which it becomes

$$f'' = f' - \cdot 0114\,(t - t').$$

This is the form to which it is reduced by M. Kupffer; and though not rigorously exact, the error is generally negligible, within the ordinary variations of atmospheric temperature and pressure. In the case of observations on high mountains, however, it will be indispensable to employ the complete formula, otherwise the calculated dew-point would be appreciably lower than the truth. In illustration of this point, I subjoin the particulars of an observation made on the Sugarloaf mountain in the vicinity of Bray, the dew-point being experimentally determined by Daniell's hygrometer, and

calculated by my formula, in its complete and less perfect form, from the observed temperatures of a wet and dry thermometer.

(Top of Sugar-loaf, April 23, 1840.)

$$t = 60°{\cdot}8; \quad t' = 53°{\cdot}2; \quad t - t' = 7°{\cdot}6; \quad p = 28{\cdot}516.$$

$$t'' \text{ (by Daniell's hygrometer)} = 47.5.$$

$$t'' \left(\text{by formula } f'' = f' - {\cdot}0114\,(t - t') \times \frac{p - f'}{30}\right) = 46°{\cdot}8.$$

$$t'' \text{ (by formula } f'' = f' - {\cdot}0114\,(t - t')\,) = 46°{\cdot}22.$$

"Thus, by neglecting the factor $\frac{p-f'}{30}$, which, in the preceding observation, $=$ ·9366, the calculated dew-point comes out 0°·58 too low. This, however, may, under ordinary circumstances, be considered as an extreme error; for $t - t'$ is seldom so high as 7·6, and $\frac{p-f'}{30}$ scarcely ever so low as ·9366, at least in this climate."

May 25.

REV. H. LLOYD, A.M., Vice-President, in the Chair.

A paper was read by the Secretary, being a continuation of Mr. George J. Knox's researches "on the Direction and Mode of Propagation of the Electric Force, and on the Source of Electrical Development."

In the commencement of this paper the Author describes some experiments, from which he concludes that *all fluids* convey the electric force through their substance; while with regard to *solids* no regular law exists, some conveying the electric force through their substance, while others convey it along their surface. He next considers the source of electrical development, and shows that it must originate in

contact, and not in chemical action, by a reference to experiments which prove that there is development of electricity by contact where chemical action could not take place, (as in the case of gold and platinum,) and by showing that all the experiments adduced in favour of chemical action, receive an easy solution on the contact theory. He then shows how completely the electrical machine illustrates every anomalous action in the voltaic pile, when the contact theory, and his explanation of chemical action by alternate states of induction and equilibrium, are adopted.

The Author then explains, (as a further proof of the correctness of his theory of alternate states of induction and equilibrium,) in what manner, according to this theory, a current of electricity must, at making and breaking contact, produce induced currents in opposite directions; and he concludes with a few remarks upon magnetism considered as an electrical phenomenon.

The Rev. Dr. Todd announced to the Academy that the transcript of the Book of Lismore, borrowed some time ago by the Council from his Grace the Duke of Devonshire, was now completed; and he exhibited it, together with the original, to the meeting.

After some remarks on the beauty of the transcript, which was made by Mr. Eugene Curry, and the means taken to secure its accuracy, Dr. Todd proceeded to give some account of the original MS.; the circumstances under which it was discovered in the Castle of Lismore, in 1814; and its subsequent history. He showed that it received the name of "the Book of Lismore" merely because it happened to be found in that Castle, and that it had no connexion with the Church of Lismore, as the appellation of *Book of Lismore* would imply. It was written probably for some members of the Mac Carthy family, and was a sort of *Bibliotheca*, or collection of tracts on all such subjects as appeared

interesting in religion, legendary lore, and history, in the fourteenth century, at which period the book was most probably written.

After describing the various mutilations which the volume appears to have sustained, Dr. Todd proceeded to describe its contents, and to make some remarks on the sources of the different tracts contained in it. These are, Lives of St. Patrick, St. Columkille, St. Bridget of Kildare, St. Senan of Scattery Island, St. Finnen of Clonard, and St. Finnchua of Brigown, all in Irish of great purity and antiquity; the conquests of Charlemagne, taken from the celebrated romance of the middle ages, falsely attributed to Tilpin, or Turpin, Archbishop of Rheims; several legends, as the story of All-hallowtide, of Antichrist, of St. Canice of Aghaboe, of David and Solomon, of a Christian and a Jewish Child, of St. Comgal of Bangor; and the history of the Lombards, from the celebrated work of Paul Warnefrid. Of this latter tract, which is full of strange tales and legends, Dr. Todd read a short portion, in an English translation. The reading of the remainder of the paper was deferred to the next meeting of the Academy.

DONATIONS.

Annales des Mines. Par les Ingenieurs des Mines. Troisiéme Série. Tome VII.—X. Presented by the School of Mines.

Journal of the Franklin Institute. Vol. XXIV. for 1839. Presented by the Society.

Asiatic Researches. Vol. XIX., Part 2. Presented by the Asiatic Society of Calcutta.

Flora Batava. By Jan Kops. Presented by the Author.

Fisher's Constantinople. Presented by Rev. R. Walsh, LL.D., M.R.I.A.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

1840. No. 24.

June 8.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

George Wilkinson, Esq., and G. Willoughby Hemans, Esq., were elected Members of the Academy.

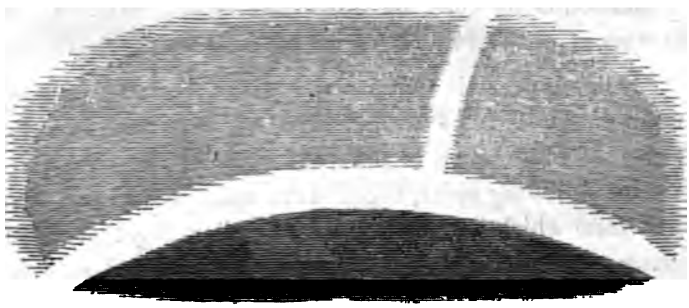
The following note, by John Ball, Esq., M.R.I.A., on the Aurora of the 24th of April, was read by the Secretary:

"It being possible that a very brilliant Aurora, which occurred on the night of Friday, April 24, may have been the subject of observation in different parts of the country, I offer the following notes, taken at the time, as a contribution to the facts which it is so desirable to collect together, in reference to these phenomena. Being unprovided with instruments, the only point of interest which I was able to attend to was the *period* at which the more observable *rapid* changes took place. To fix the position of such changes, it would have been desirable to note their exact direction by the compass, which might be done where there are several observers; but my whole attention being directed to the time, I was unable to effect this. To supply as far as possible the deficiency, I have endeavoured, by rude outlines,

to represent some of the remarkable appearances, the period of whose occurrence I have noted down; and these will probably enable other observers to recognize the changes sufficiently to allow of a comparison of the observed period of their occurrence.

"The time given is, as accurately as I could ascertain it, Liverpool mean time, which, of course, may easily be reduced to Greenwich or Dublin time, by persons anxious to compare their observations.

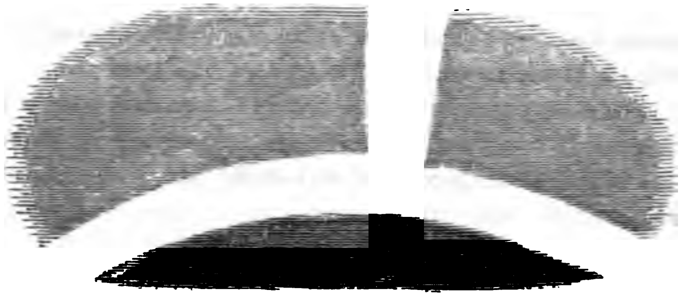
"Before 10 o'clock, P.M., I remarked a bank of light in the northern horizon, which gradually assumed the form of a very well defined arch, the luminous part being of less breadth than is usually the case. The arch continued slowly to rise, without exhibiting any appearance of streamers, until some minutes past ten, P.M., when the altitude of its upper surface may have been about 10°; it then began to exhibit an appearance resembling the glow above a furnace, and at 10^h 10^m 8^s a very brilliant streamer ascended from a little to the east of the centre of the arch.



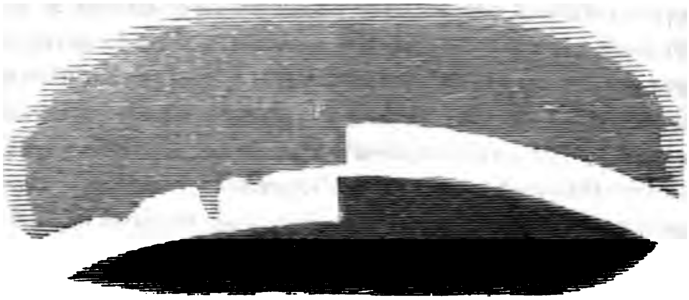
"The phenomena of streamers were now, for some minutes, exhibited with great brilliancy. At 10^h 12^m 49^s, a broad column of bright light was seen about the centre of the arch, as in the subjoined sketch.

"Up to this time the arch had preserved its regular form; but a separation now gradually took place, the bow seeming as if broken in the middle, and the eastern side remaining

throughout the most brilliant. The changes now succeeded each other so rapidly as to defy observation, the limits of the



dark interior part continually altering, and at one time appearing as if half the arch were refracted from its place.



"The arch continued to separate, and, as it were, fall to pieces, the streamers diminishing in brilliancy until $10^{h}\ 17^{m}\ 5^{s}$, when a broad column rose from very near the horizon, on the eastern side.

"This column appeared gradually to melt away, when a very brilliant streamer arose nearly in the same place at

.$10^h\ 17^m\ 53^s$, remaining fixed for a few moments; at $10^h\ 18^m\ 12^s$ this resolved itself into several bright streamers. I was unable, after this period, to fix upon any sufficiently marked appearances to admit of being noted down; the Aurora, however, continued for some time longer, till gradually obscured by a thick fog which came on at this time. Throughout the whole period, the dark part, through which I observed stars of the fifth magnitude, was remarkably well defined, presenting at times the appearance of a mountain range seen at a distance.

"I have offered this very imperfect sketch, in the hope that this fine Aurora has not escaped the notice of more accurate and better prepared observers; for, if we were supplied with a sufficient number even of such rough outlines as the preceding, we should be better enabled to answer a question very important to the subject, namely—whether different observers see the same Aurora at the same time?"

Dr. Robinson presented a specimen of Meteor Paper, similar to that of Carolath, which he had received from the Countess of Caledon, with a notice of the circumstances of its formation. It was found, last Spring, covering a considerable tract of meadow land, the property of Lord Radnor, in Gloucestershire. The tract of country between Lesblade and Farringdon is flooded by the Isis every Spring, but not more than usually this season. When the waters subsided, the surface of the ground was covered with this substance to such an extent as to make its removal and destruction necessary to permit the growth of the grass; some of the pieces covering ten and twelve acres in continuous and unbroken sheets. Nothing of the kind had been noticed before by the oldest farmers. Portions of it were found on land which had not been under water. It is denser than any which Dr. Robinson had seen, and contains a larger proportion of the shields of Infusoria; but the tissue is composed chiefly of the conferva rivularis.

Mr. Farran exhibited to the Academy a Babylonian brick, with cuneiform characters.

Rev. H. Lloyd, V.P., read the following extract of a letter from the Rev. Thomas Knox, accompanying a tabular view of the results of rain-guages observed at Toomavara, County of Tipperary, by himself, and at Monks Eleigh, Suffolk, by the Rev. Henry B. Knox, during the year 1839; together with plates of the rain curves.

" *River Glebe, Nenagh, May* 28, 1840.

" I send the combined results, for the year 1839, of a rain gauge kept by my cousin Henry and of my own; they are made on the same principle and construction as that of which I sent the previous account. As Toomavara is about forty miles from the west coast of Ireland, and Monks Eleigh, in Suffolk, (where my cousin Henry resides,) about a similar distance from the east coast of England, we think the comparative view of the direction and amount of rain may, perhaps, prove interesting to the Academy.

" There are a few points to which we wish to draw more particular attention: In the first place, there is a striking resemblance between the mean curve of the twelve months, and that from Winter to Summer solstice at each place respectively, so that the latter nearly represents the nature of the yearly rain of the place—I mean with regard to the point of the compass from which it comes; this you will see by comparing plates thirteen and eighteen.

" Again, in the mean for each season, the greatest amount of rain, at Toomavara, is invariably from S.W., whereas, at Monks Eleigh, in Winter it is from W., in Spring from N., in Summer E., and in Autumn S. Again, when the year is divided into two periods, from Autumnal to Spring, and from Spring to Autumnal Equinox, the greatest rain, for each period, is at Toomavara from the S. W., and at Monks Eleigh from W. During the entire year, the greatest amount at Toomavara is from the S. W., but at Monks Eleigh from W.; and, though

the gross total of rain at Toomavara is nearly double that at Monks Eleigh for the year, still the easterly rains at the latter place are almost equal in amount, and, during the Summer and Autumn, much more considerable. If, on an examination of the mean results of many years, the *same directions* of rain are found to be nearly the same in amount, it will render the subject very interesting to meteorologists.

"I have added also a plate of the years 1838 and 1839, for Toomavara alone; the mode in which the curves are described is stated in the Proceedings for 1838, No. 10, p. 146.

"On some future occasion, we hope to be able to lay before the Academy the results of many years."

A Comparative View of the Results of Rain-Guages observed at Toomavara, County of Tipperary, by Rev. Thomas Knox, and at Monks Eleigh in Suffolk, by Rev. Henry B. Knox.

12 Months.		S.	S. W.	W.	N. W.	N.	N. E.	E.	S. E.	Total.
December	T.	·469	1·034	·631	·188	·081	·028	·050	·133	2·614
	M. E.	·421	·333	·431	·150	·040	· —	·015	·070	1·460
January	T.	·155	·926	1·080	·096	·061	·050	·010	·010	2·388
	M. E.	·147	·246	·705	·099	·078	·075	·033	·070	1·453
February	T.	·383	1·333	1·073	·386	·124	·212	·296	·202	4·009
	M. E.	·157	·326	·636	·080	·059	·080	·194	·213	1·745
March ..	T.	·509	1·088	1·188	·340	·218	·136	·312	·388	4·179
	M. E.	·251	·345	·128	·229	·099	·020	·040	·110	1·222
April ...	T.	·152	·458	·571	·162	·105	·341	·300	·176	2·265
	M. E.	·058	·218	·528	·102	·206	·060	·178	·002	1·352
May	T.	·110	·461	·205	·070	·172	·032	·045	·312	1·407
	M. E.	·008	—	·003	·031	·593	·352	·043	· —	1·030
June....	T.	·316	1·371	·255	·055	·036	·499	·200	·130	2·862
	M. E.	·176	·200	·290	·517	·636	·172	·645	039	2·675
July	T.	·317	1·281	·733	·483	·832	·840	·837	·245	5·568
	M. E.	·207	·113	·282	·224	·140	·051	·719	·383	2·119
August ..	T.	·236	1·188	·460	·087	·200	·062	·160	·169	2·562
	M. E.	·044	·176	·246	·207	·186	·520	·100	·015	1.494
Septem...	T.	·712	2·428	1·061	·115	·335	·047	·075	·515	5·288
	M. E.	·442	·431	·662	·593	·291	·213	·228	·287	3·147
October..	T.	·306	·848	·724	·399	·905	·810	·187	·201	4·380
	M. E.	·201	·106	·071	·085	·110	·308	·155	·150	1·186
Novem...	T.	·584	·280	·169	·259	·046	·021	·629	1·042	3·030
	M. E.	·562	·262	·389	·075	·338	·176	·742	·369	2·913
Total ...	T.	4·249	12·696	8·150	2·640	3·115	3·078	3·101	3·523	40 552
	M. E.	2·674	2·756	4·371	2·392	2·776	2·027	3·092	1·708	21·796

Mean Results, &c. &c.		S.	S. W.	W.	N. W.	N.	N. E.	E.	S. E
Mean of Winter....	T.	·336	1·098	·928	·223	·089	·097	·119	·115
	M. E.	·242	·302	·591	·110	·059	·052	·081	·118
Do. Spring........	T.	·257	·669	·655	·191	·105	·170	·219	·292
	M. E.	·106	·188	·220	·117	·299	·144	·087	·037
Do. Summer	T.	·290	1·280	·483	·208	·356	·467	·399	·181
	M. E.	·142	·163	·273	·316	·321	·248	·488	·146
Do. Autumn	T.	·534	1·185	·651	·258	·429	·293	·297	·586
	M. E.	·402	·266	·374	·251	·246	·232	·375	·269
Total from Winter to Summer Solstice, Dec. 1838, June 1839	T.	1·720	5·858	4·618	1·245	·776	1·278	1·180	1·238
	M. E.	1·036	1·370	2·142	·659	1·085	·740	1·100	·475
Total from Summer to Winter Solstice, June to Dec. 1839.	T.	2·761	6·628	3·315	1·365	2·337	1·940	2·195	2·973
	M. E.	2·157	1·376	1·906	1·621	1·962	1·409	2·050	1·520
Total from Autumnal to Spring Equinox, Sept. 1838, to March 1839.	T.	2·649	6·611	5·068	1·291	·982	·594	1·741	1·318
	M. E.	1·489	1·796	2·642	·810	1·628	·602	1·555	·831
Total from Spring to Autumnal Equinox, March to Sept. 1839.	T.	1·816	7·058	3·768	1·118	1·745	1·875	1·660	1·273
	M. E.	·940	1.178	2·032	1·488	1·870	1·362	1·913	·726

William Pike, Esq. presented to the Academy an Irish Quern, and some other ancient remains, found at Roughan Island.

On removing the dam from the millrace, leading from Roughan lake, near Dungannon, when the water subsided, an island appeared nearly in the middle of the lake, which, on examination, appeared to have been artificially formed of timber and peat. The quern presented was found on the surface; and numerous fragments of ancient pottery, and bones, and a few bronze spear heads, were discovered at the depth of a few inches.

Mr. Patterson exhibited to the Meeting a massive Gold Ring, (of the form supposed to be the ancient ring-money,) recently found near Belfast.

The President continued his account of his "Second Series of Researches respecting Vibration."

DONATIONS.

Journal of the Royal Asiatic Society. No. XI. Presented by the Society.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences. Premier Semestre, 1840, Nos. 13—19, and Index. Presented by the Institute.

A Quern, Fragments of Pottery, and Animal Remains, found on Roughan Island. Presented by Wm. Pike, Esq.

A Letter to the President of the Royal Irish Academy, in reply to certain Charges made against George Petrie, Esq. Presented by the Author.

A Manuscript Copy of Keating's History of Ireland, by Andrew M'Curtin, dated at Ibrickan, County of Clare, A.D. 1703. Presented by Richard Carmichael, Esq.

A bronze Axe. Presented by the same.

June 22.

SIR WM. R. HAMILTON, LL.D., President, in the Chair.

The Rev. Dr. Todd continued his account of the contents of the Book of Lismore.

The tracts next in order in this volume are legends of ecclesiastical history,—as the legend of the venerable Bede; of St. Petronilla, the daughter of St. Peter; of the discovery of the Sybilline Oracle, in a stone coffin at Rome; of St. Gregory the Great; the heresy of the Empress Justina. Then follow tracts on the origin of some of the minor ceremonies of the mass; an account of the successors of Charlemagne; the controversy of Archbishop Lanfranc with the Romans, about Transubstantiation; a battle between the priests of Rome and the devil; extracts from the voyage of Marco Polo, translated into Irish; a very ancient tract on the wars of the celebrated Callaghan Cashel, King of Munster, with the Danes, in the tenth century; a romantic tale, entitled, The Adventures of Teige, the son of Cian, the son of Oilliol Olum, King of

Munster; an account of the battle of Crionna, between Cormac Mac Art and the Ultonians; the adventures of Laoghaire, son of a King of Connaught, with the fairies; the manner in which Connor Mac Nessa, son of a Druid, obtained the crown of Munster; a very curious historical tale, entitled, The Seige of Druim Damhghaire, now Knocklong, in the County of Limerick. This tale is of great importance, from its undoubted antiquity, and the topographical descriptions which it contains of the country about Fermoy, in the County of Cork.

The last tract in the MS. is one of very great interest: it is in the form of a dialogue between St. Patrick and the two survivors of Fiana Eireann,—Caoilte Mac Ronain and Oisin, son of Finn Mac Cumhail. It describes the situation of several hills, mountains, rivers, caverns, rills, &c., in Ireland, with the derivation of their names. It is much to be regretted, that this very curious tract is imperfect, especially as no other copy of it is known to exist. But for these defects we should probably have found in this tract notices of almost every monument of note in ancient Ireland: and, even in its present mutilated state, it cannot but be regarded as preserving the most ancient traditions to which we can now have access,—traditions which were committed to writing at a period when the ancient customs of the people were unbroken and undisturbed.

Rev. H. Lloyd, V.P., gave an account of a series of observations of the Magnetic Declination, made by Professor Bache of Philadelphia and himself, in the hope of determining thereby differences of longitude.

It is well known that the magnetic declination, at a given place, is subject to frequent and irregular variations, and that corresponding changes occur, at the same instant of time, at very distant places. The first recognition of this remarkable phenomenon seems to have been made by Arago, while comparing the observations of declination made by

himself, at Paris, in the year 1818, with the contemporaneous observations of M. Kupffer, at Casan. Not long after, the subject underwent a fuller investigation in the hands of Humboldt; and, in the year 1827, an extensive system of simultaneous observations was organized by that illustrious philosopher for the purpose of elucidating it. At length, in 1834, it was taken up by Gauss, and received a much greater development. Gauss discovered that the irregular changes of the declination were of *continual* occurrence; and that the synchronism, which had been previously observed only in the larger changes, extended to the minutest movements. In order to investigate the law of these synchronous changes, and the locality and other circumstances of the acting forces, Gauss arranged the extensive plan of simultaneous observations at short intervals, which has been already four years in operation, and in which almost every country in Europe has been represented by some one or more observers.

Having taken part in this combined system in the year 1837, Prof. Lloyd was led to inquire, in the first place, whether this irregular fluctuation of the declination might not be still more rapid than appeared from the observations hitherto made; and, secondly, whether these shorter oscillations (if they existed) corresponded in distant places, and could therefore be employed to determine differences of longitude.

To investigate the first of these questions, a series of observations was made in the month of September, 1837, at very short intervals. The instrument employed was Gauss's magnetometer; and the magnet being in a state of continued vibration, observations were taken at each succeeding maximum elongation, and therefore at the interval of a single oscillation,—which, in the case of the bar employed, was $27^s.38$. The mean of each successive pair of readings was then taken, to eliminate the mechanical oscillation, and the results projected in curves in the usual manner. On an

examination of these curves it appeared, as had been anticipated, that the maxima and minima of the irregular movements usually succeeded each other with very great rapidity, their interval being, on the average, about 40 seconds, and their magnitude varying in these observations from 10″ to 60″.

The observations were resumed on the 23rd of October, and continued to the 26th, two series of an hour's duration being made each day, in the hope of detecting some law governing the movements. No such law however could be traced, nor did there appear to be any connexion between the curves representing the march of the changes, at different hours of the same day, or at the same hour on successive days.

The observed variations in these observations being small, it was suggested by an experienced friend, to whom Prof. Lloyd showed the results, that they were not true magnetic changes, but merely the errors of observation incidental to vibratory movement. In order to test this supposition, an unmagnetic bar (the brass detorsion bar of Gauss's apparatus) was substituted for the magnet, to which it corresponded in dimension; and being provided with a mirror, was suspended by two parallel threads, and made to vibrate. The time of vibration was adjusted, by varying the interval of the threads, so as to differ little from that of the magnet. The successive elongations were then observed, as in the case of the magnet, and the means of each pair taken. The variations in these means (which could arise from errors of observation or mechanical changes only) bore no comparison whatever in magnitude to the corresponding variations of position of the magnetic bar, thus showing that the latter were truly the results of the operation of magnetic forces.

The rapidity with which these changes thus appeared to follow each other, held out the hope that they might be employed in determining differences of longitude; and it only remained to ascertain, for that purpose, whether variations so

inconsiderable in magnitude corresponded at great distances. If such should prove to be the fact, it would be only necessary to project on a large scale the results of the observations made about the same absolute time at the two stations, and to compare the times of the corresponding maxima and minima. In the observations already referred to, the maxima and minima succeeded each other (as has been said) at intervals of about forty seconds, and the epoch of their occurrence was probably known to six or seven seconds. By shortening still further the interval of observation, it is manifest that this error may be much diminished. The corresponding error of the difference of longitude resulting from a single comparison (supposing the probable error of epoch to be the same at the two places,) will be greater in the ratio of $\sqrt{2}$ to 1; but this error, owing to the multitude of the maxima and minima compared, must necessarily be greatly reduced in the final mean.

In order to put this question to the test on the largest scale, it was agreed between Mr. Bache and Mr. Lloyd, to make a series of corresponding observations in Philadelphia and in Dublin. Some difficulties occurred in concerting a plan, and Prof. Bache underwent, in one instance, the labour of an extensive series of observations, without any counterpart in Dublin. At length, however, it was agreed to observe during the week commencing the 11th of November, 1839; the observations being taken during two hours on each day—namely, from 12 to 1 P.M., and from 8 to 9 P.M., Greenwich mean time.

Prof. Bache's account of his observations is contained in the following extract of a letter which accompanied them, dated November 29, 1839.

"The place of observation is a room in one of the out buildings for the dwellings of the Professors of the Girard College. As the materials used in the construction of the house must produce considerable local attrac-

tion, no absolute measures have been attempted. All moveable magnetic substances were removed from the vicinity of the needle. A window near the needle was carefully closed by a shutter of wood, and by two curtains fastened to the window frame, and with an interval between them. There is no fire in the room; and a double door is between the observing room and an adjoining one where there is a fire.

" The instrument is one of Gauss's declination magnetometers, made by Meyerstein of Gottingen. The arrangement of it agrees exactly with that described in the *Resultate*, which has been followed as nearly as possible. The reading telescope is supported upon a small wooden shelf fastened to one of the side walls of the room; the scale is attached to a wooden frame before the shelf. One of the smallest divisions of the scale, which is divided by estimation in the observations to tenths, is $25''\cdot975$ nearly in value. The zero of the scale did not vary sensibly in position during the observations.

" The observations were made every eight seconds, an assistant striking two seconds before the time of each observation. The ticks of the half-seconds chronometer being distinctly audible, the observation was made at the fourth beat after the signal given by the assistant, and thus the time was independent of the minute accuracy of the signal. Checks were adopted to prevent or detect large errors in giving the signal. The interval of eight seconds is very nearly one-third of the time of oscillation of the magnet bar.

" The time was observed by a chronometer beating half seconds. This was compared before and after each set of magnetic observations with one, and after the morning of the 14th with two chronometers. One of these was carried from the Girard College to the city after each set of observations; but the others remained during the night at the Girard College, and were removed to the city after the morning

series, to compare them with the stationary chronometer belonging to the High School Observatory, the rate of which was ascertained by observations of transit of the sun and stars on the 6th, 9th, 11th, 13th, and 16th of November. Girard College is about 1770 feet west, and 8050 north of the High School by the city map."

The Dublin observations were made in the Magnetical Observatory. The instrument employed is of the form described some time since to the Academy.* It is a magnetic collimator with a graduated scale of glass, each division of which corresponds to $43''\cdot22$ of arc. The visual angle under which each division is seen is so considerable, that the divisions can readily be subdivided into tenths by estimation. The time of vibration of the magnet is $17^{s}\cdot78$. The apparatus containing the magnet, as well as the reading telescope, are supported on stone pillars resting on solid masonry, and insulated from the floor.

The observations having been undertaken by Prof. Lloyd without assistance, it was found impracticable to observe at intervals shorter than the time of vibration of the magnet bar, of which each successive elongation was accordingly noted. The time shown by the chronometer was usually noted every tenth or twelfth vibration; and thus the time of the intervening observations could be interpolated with much exactness. The error of the chronometer was obtained on the nights of the 11th, 14th, and 19th of November, by transit observations with the four-foot transit of the Observatory.

Of these observations, those made on Wednesday, Nov. 13, (8—9) P. M. Greenwich mean time, were the most favourable for the purpose contemplated. The changes, though small, (from $5''$ to $50''$,) were marked and rapid, the intervals of the successive maxima and minima averaging thirty-six seconds. The epoch of their occurrence seems to be determinable to between four and five seconds.

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* See Proceedings, No. 13, p. 330, *et seq.*

When the two sets of observations were reduced and laid down in curves, it was found that they presented no similarity; in other words, that there was *no correspondence whatever between the smaller changes of the declination at Dublin and at Philadelphia.* The determination of differences of longitude, by means of the magnet, is, therefore, impracticable at such distances; but the attempt has revealed the important fact, that the irregular changes of declination, which have exhibited so marked a correspondence at the most distant stations at which simultaneous observations have been heretofore made, do not correspond on the American and European Continents. Prof. Lloyd observed that much light would, erelong, be thrown upon this curious subject, by a comparison of the observations made at the Magnetical Observatory of Toronto, in Upper Canada, with those of Europe.

A Paper "on the Cooling Power of Gases," by Thomas Andrews, M.D.,M.R.I.A., was read by Dr. Apjohn.

Leslie observed, long ago, that a heated body cools more rapidly in hydrogen gas than in atmospheric air; but Dalton and Davy were the first who attempted to estimate the cooling powers of the gases, by observing the times which a thermometer, heated to the same point, took to cool through the same number of degrees in different gases. So difficult of execution, however, is this method, that their results differ, in every respect, most widely from each other: thus, for example, Davy found that a thermometer cooled twice as fast in olefiant gas as in nitrous oxide, while Dalton found the rate of cooling in both these gases to be the same.

The subject appeared to be deserving of further investigation, and the author has endeavoured to pursue it by a novel method, which may, perhaps, be susceptible of other applications in inquiries connected with the science of heat.

When a fine metallic wire is placed in the circuit of a voltaic circle, it is well known that it will become heated, and the temperature which it finally acquires (provided the length of the wire remain the same, and the action of the battery continue constant) will depend upon the cooling power of the medium in which the wire is placed. If the current be of sufficient intensity to heat the wire to redness in air, the variations in its appearance, when placed in other gases, will exhibit, at a glance, their relative cooling powers. But, since the conducting power of wires for electricity diminishes as their temperature rises, a measure of the effect may be obtained by ascertaining the changes produced in the intensity of the current, which will increase or diminish, according to the greater or less cooling power of the medium in which the wire is placed.

The battery, employed in the following experiments, consisted of four large cells, on Daniell's construction, charged with his standard solutions; and of a small cell, composed of an exterior cylinder of amalgamated zinc, and an interior plate of platina, the latter being separated from the former by a cylindrical membrane, and both immersed in dilute sulphuric acid. The hydrogen gas, disengaged from the platina plate, was collected in a graduated tube, and its volume taken as a measure of the intensity of the current. A platina wire, about 2·5 inches long, and $\frac{1}{120}$ in diameter, was stretched in the middle of a wide glass tube, by means of copper pincers, which were connected by thick wires of the same metal with the poles of the battery. The glass tube was so adjusted as to be easily traversed by a current of gas, which afterwards escaped from beneath a surface of mercury, and the connecting wires being passed through collars of caoutchouc, the whole apparatus was rendered perfectly air-tight.

In making the observations, a current of the gas, carefully dried, was passed in great excess through the appara-

tus, in order to sweep away, as completely as possible, the atmospheric air; the current was then arrested, and, the connexions with the battery being established, the appearance presented by the heated wire was noted, and the intensity of the current transmitted through it ascertained by collecting the hydrogen evolved in the small cell during the space of two minutes. The gas was next displaced by a current of dry air, and the same experiment repeated. During these experiments the battery was always in a very constant state of action. The results are contained in the following table, in which the second column gives the quantity of hydrogen extricated at each experiment with the wire in air; the third with the wire in the gas; and the fourth column expresses the ratios of these numbers—those in the second being taken as unit:—

Name of Gas.	Intensity. Wire in air.	Intensity. Wire in gas.	Ratio of Int. that in air=1.
Muriatic acid, . . .	65·9	63·1	0·958
Sulphuric acid, . . .	69·2	66·9	0·967
Nitrogen, ...	67·3	67·	0·995
Carbonic oxide, . . .	68·1	68·3	1·003
Cyanogen, ...	66·3	67·	1·010
Carbonic acid, . . .	66·6	67·5	1·013
Deutoxide of nitrogen,	66·2	67·3	1·016
Protoxide of nitrogen, .	68·3	69·6	1·019
Oxygen, ...	68·3	69·6	1·019
Olefiant gas, ...	68·2	76·2	1·171
Ammonia, ...	67·4	75·3	1·118
Hydrogen, ...	67·0	92·6	1·382

As, however, the law, which connects the intensity of a voltaic current traversing a wire with the temperature to which it raises the wire, is unknown, these numbers do not furnish us with the means of determining the exact variations of temperature, sustained by the wire which was employed in these experiments. But, as a term of comparison, it

may be mentioned that, when the wire was immersed in distilled water which prevented its temperature from sensibly rising, the intensity of the current was almost exactly twice as great as when the wire was allowed to become heated, in atmospheric air at the ordinary pressure.

The appearances presented by the platina wire corresponded with the foregoing results. In atmospheric air, it exhibited a bright red heat; in the muriatic and sulphurous acid gases, the redness was distinctly a shade brighter; in cyanogen, carbonic oxide, and hydrogen, there was no sensible difference; in carbonic acid, oxygen, and the deutoxide of nitrogen, the wire, so far as the eye could judge, appeared rather duller than in air; while, in olefiant gas and ammonia, it was only raised to a very obscure red heat, and in hydrogen, no redness whatever was visible, even in complete darkness. This method may, it is obvious, be extended to vapours; and, from some trials made with them, it appeared that the cooling powers of the vapours of alcohol and ether are considerably greater than the cooling power of air, and that of steam very slightly greater. On the other hand, the cooling power of all gases diminishes as they become rarefied; so much so, that the platina wire used in the preceding experiments reached in vacuum nearly its point of fusion, while, at the same time, the intensity of the current considerably diminished.

The gases may be conveniently arranged into the following groups, in reference to their cooling powers; and it will be found, on inspecting the table, that those arranged in each group differ little in this property from each other:—

Group I. Gases whose cooling power is less than that of atmospheric air:—sulphurous acid, muriatic acid.

Group II. Gases whose cooling power is nearly the same:—nitrogen, carbonic oxide, cyanogen, carbonic acid, deutoxide of nitrogen, protoxide of nitrogen, oxygen, vapour of water.

Group III. Gases whose cooling power is greater:—olefiant gas, ammonia, vapours of alcohol and ether.

Group IV. Hydrogen.

Dr. Apjohn next drew the attention of the Academy to a metallic ore recently found at the Kilbricken Lead Mine, County of Clare, which he had received through a friend from Mr. M. Taylor, the gentleman who conducts the mining operations in that district. It occurs in amorphous masses of a bluish grey colour; has a metallic lustre, and something between a compact earthy and close foliated structure. Specific gravity =6·407; hardness intermediate between that of galena and sulphuret of antimony. Subjected to the action of the blowpipe sulphur is burned off; white oxide of antimony is deposited upon the charcoal; and a metallic globule is produced, brittle at first, but which becomes malleable lead after having been submitted for some time to the action of the oxidating flame. In muriatic acid the ore dissolves, though slowly, with the evolution of sulphuretted hydrogen; and the solution, when poured into a large quantity of boiling water, gives a white precipitate (oxichloride of antimony.) When this precipitate has subsided, the solution is found to contain nothing but chloride of lead, with traces of antimony and iron. From these experiments the mineral was concluded to be a combination of sulphur, lead, and antimony; and to determine the proportions in which they were associated, the following analytic process was adopted.

44·52 grains of the ore, previously reduced to a fine powder, were introduced into a ball, blown upon a tube of Bohemian glass; and through this a current of dry chlorine was made to pass, the arrangement of the apparatus being such, that by a rectangular bend in the portion of the tube beyond the ball, the chlorine was made to bubble through a

dilute solution of tartaric acid. This acid was placed in a tall flint-glass bottle with narrow neck, the mouth of which was closed (but not air tight) by a cork which was perforated so to receive the vertical arm of the bent tube. Upon contact of the chlorine and ore considerable heat was developed. When, the current of gas being still maintained, this began to subside, a lighted spirit lamp with circular wick was placed beneath the ball, and its flame gradually augmented so as to expel the chlorides of sulphur and antimony, and finally to fuse the chloride of lead; and a smaller spirit flame was at the same time made to play on the tube beyond the ball, so as to cause the volatile chlorides to pass into the tartaric acid, or at least into the vertical portion of the tube whose further extremity was immersed in the acid solution. The tube was now nicked with a file, and broken across at its point of flexure; and the portion not connected with the ball was subjected to a stream of distilled water, so as to wash any chlorides which it might include into the bottle containing the tartaric acid. This portion of the tube was now heated to redness, so as to render it perfectly dry, and then weighed along with the remaining fragment on which the ball was blown, and which contained the chloride of lead. The weight of this chloride was thus obtained; being obviously equal to the weight last obtained, diminished by the weight of the ball and tube. It was thus found to amount to 40·96 grains, equivalent to 30·52 of metallic lead. The remaining constituents of the ore were now in the tartaric acid, the sulphur being partly in the free state, but chiefly in the form of sulphuric acid. The free sulphur was first separated, and found to weigh 0·1 grain. To the acid solution chloride of barium was added, which threw down the sulphuric acid in the form of sulphate of barytes. This, when well washed, dried, and ignited, weighed 51·87 grains, equivalent to 7·15 sulphur; hence $7{\cdot}15 + 0{\cdot}10 = 7{\cdot}25$ is the total amount of the sulphur.

Sulphuric acid was next added, to precipitate any excess of barytes; and, this being separated by filtration, sulphuretted hydrogen was passed through the solution, which threw down the antimony as orange tersulphuret. The vessel being placed upon the sand bath for about an hour, so as to expel any excess of sulphuretted hydrogen, the precipitate was collected on a filter, and exposed for a considerable time to a temperature not exceeding 212°. Being thus rendered perfectly dry, it was found to weigh 8·85 grains, equivalent to 6·37 metallic antimony.

The solution from which the antimony was separated was supersaturated with ammonia, and sulphuretted hydrogen was again passed through it, which threw down the iron; upon this precipitate nitro-muriatic acid was digested, and the unacidified sulphur being separated by a filter, the acid solution was supersaturated with ammonia, which threw down peroxide of iron, weighing, when ignited, 0·244 grains, equivalent to 0·17 grains of iron. The following, therefore, are the results of the analysis:

Sulphur	7·25
Lead	30·52
Iron	0·17
Antimony	6·37
Loss	0·21

100 parts therefore of the ore consist of

	(1)	(2)	(3)	(4)
Sulphur . . .	16·36	1·016	1·016	9·153
Lead . . .	68·87	0·664	0·677	6·099
Iron . . .	0·38	0·013		
Antimony . .	14·39	0·111	0·111	1·000
	100			

The numbers in column (2) are the quotients obtained by dividing the corresponding ones in column (1) by the atomic

weights of the substances they represent. The numbers in column (3) are the same as those in (2), with the exception that the quotients for the lead and iron are added together. In (4) we have other numbers in the same ratio as the preceding. A mere inspection of the latter is sufficient to show that the empirical formula of the mineral is $S_9\,Pb_6\,Sb_1$; and such being the case, there can be no doubt that the rational formula is

$$6\ (S,\ Pb) + S_3,\ Sb,$$

or that it consists of six atoms of sulphuret of lead associated with one atom of tersulphuret of antimony, a little of the former metal being replaced by an equivalent quantity of iron.

The above are the particulars of the analysis which appeared on the whole to have been most successfully performed; the analysis, however, was repeated three times, and the results in each instance conducted to the formula just given. In the first trials, in consequence of strongly heating the ball traversed by the chlorine from the very commencement of the experiment, some of the chloride of lead was volatilized, and Dr. Apjohn was led to conclude the constitution of the mineral to be materially different from what it afterwards proved to be. The ball should not be heated until the spontaneous action of the chlorine on the ore has ceased.

Kilbrickenite, as Dr. Apjohn proposed to call this mineral, is obviously what Berzelius denominates a sulphur salt, i. e., a combination of an electro-negative with an electro-positive sulphuret. But there are several other ores known to mineralogists composed of the same proximate constituents, or including sulphuret of lead in association with the sulphuret of antimony. The subjoined list comprehends those which have been analysed and described.

Zinkenite	$S, Pb + S_3, Sb$.
Plagionite . . .	$4 (S, Pb) + 3 (S_3, Sb)$.
Jamesonite . . .	$[5 (S, Pb) + S_3, Pb_2] + 4 (S_3, Sb)$?
Feather ore of lead	$2 (S, Pb) + S_3, Sb$.
Boulangerite . .	$3 (S, Pb) + S_3, Sb$.

A mere inspection of the formulæ is sufficient to show that each mineral in this list is distinct in composition from that whose analysis has been given above. There is, however, an ore possessing a constitution perfectly analogous to the Irish mineral—namely, the *sprödglaserz* of Mohs and Werner, or what Dr. Thomson calls *brittle silver glance*. The formula of this mineral Rose has shown to be $6 (S, Ag) + S_3, Sb$; so that it differs from *Kilbrickenite* merely in containing silver instead of lead.

The following note—"On a principle for producing an everburning Flame," by George J. Knox, Esq., was read by the Secretary:

"A belief in the discovery of an everburning lamp appears to have been prevalent in all ages; and tradition informs us that lamps have been found in tombs, where they have continued burning for upwards of 1000 years, of which mention has been made in the works of St. Austin, Plutarch, Pliny, Ludovicus Vives, Baptista Porta, and Licetus. The Rosecrucians,* who laid claim to the knowledge of everything mysterious, pretended to have rediscovered the secret of their construction, which was supposed to have been buried in the tomb of their founder. Dr. Plott,† in a treatise which he has written upon this subject, alludes to a lamp mentioned by St. Austin in his book *de Civitate Dei*, which was hung up in the temple of Venus; and to another found in the tomb of Pallas the Arcadian, who was slain by Turnus in the Trojan war, which continued to burn after

* Spectator, vol. v. No. 379.

† Lowthorp's Abridgment of Phil. Trans. vol. iii. (636).

its removal from the tomb and exposure to the air—proving that these lamps were not supplied from any bituminous source, or volcanic fire. He considers the requisites for an everburning lamp to be,—a perpetual wick, which might be made of gold wire, or asbestus; and a perpetual supply of fuel, which he imagines the bituminous springs of Pitchford, in Shropshire, or the inflammable gases issuing from fissures in coal mines, would afford. That such could supply fuel for a flame, so long as the bituminous spring existed, or the gas continued to exhale from the mines, is evident; but it no more deserves the appellation of an everburning lamp, than does a fire arising from any volcanic source. The desideratum for such a lamp is, that it should contain, within itself, a *renovating* principle, such as, probably, does the luminous atmosphere encompassing the body of the sun, supposed by Sir William Herschel to be electrical.

"That electricity was the principle upon which such a lamp could be constructed having occurred to me some years ago, I reflected upon the different means by which a constant light could be produced from this source, and concluded that, if by an arrangement of metals a thermo-electric current could be produced of sufficient intensity to decompose water, the heat produced by the burning of the two gases arising from the decomposition, would be sufficient, when applied to the alternate metallic junctions, to continue the electrical current of the thermo-electric pile; while the gases, which in burning become aqueous vapour, might be condensed by passing through a long tube, through which being conveyed to the closed vessel in which the water had been originally placed, they would again undergo decomposition, recombination, and condensation. Such a thermo-electric arrangement has been discovered by Prof. Botto of Turin, who has obtained decomposition of water from a series composed of a great number of wires of

platinum and iron. To prevent the apparatus from acquiring in time the same temperature, the alternate junctions of the metals, to which the heat is not applied, might be connected with the pedestal upon which the lamp is placed; and the pedestal be either allowed to rest in a cold situation, or else be connected by wires with some extensive cooling surface."

The President gave an account of some investigations respecting *Fluctuating Functions*, from which the following are extracts:—

"Let P_x denote any real function x, continuous or discontinuous, but such that its first and second integrals,

$$\int_0^x dx\, \mathrm{P}_x, \text{ and } \left(\int_0^x dx\right)^2 \mathrm{P}_x,$$

are always comprised between given finite limits. Let also the equation

$$\left(\int_0^x dx\right)^2 \mathrm{P}_x = \mu,$$

in which μ is some given constant, have infinitely many real roots, both positive and negative, which are not themselves comprised between any finite limits, but are such that the interval between any one and the next greater root is never greater than some given finite interval. Then,

$$\lim_{t=\infty} \int_a^b dx \int_0^{tx} dy\, \mathrm{P}_y\, \mathrm{F}_x = 0, \qquad \text{(A)}$$

if a and b are any finite values of x, between which the function F_x is finite.

"Again, the same things being supposed, let the arbitrary function F_x vary gradually between the same values of x; and let P_x be finite and vary gradually when x is infinitely small; then

$$\mathrm{F}_y = \varpi^{-1} \int_0^\infty dt \int_a^b dx\, \mathrm{P}_{tx-ty}\, \mathrm{F}_x, \left(y {> a \atop < b}\right), \qquad \text{(B)}$$

in which

$$\varpi = \int_{-\infty}^{\infty} dx \int_{0}^{1} dt \; P_{tx}.$$

"For the case $y=a$, we must change ϖ, in (B), to

$$\varpi' = \int_{0}^{\infty} dx \int_{0}^{1} dt \; P_{tx};$$

and for the case $y=b$, we must change it to

$$\varpi'' = \int_{-\infty}^{0} dx \int_{0}^{1} dt \; P_{tx}.$$

"For values of $y > b$, or $< a$, the second member of the formula (B) vanishes.

"If F_x, although finite, were to receive any sudden change for some particular value of y between a and b, so as to pass suddenly from the value F'' to the value F', we should then have, for this value of y,

$$\int_{0}^{\infty} dt \int_{a}^{b} dx \; P_{tx-ty} \; F_x = \varpi' F' + \varpi'' F''.$$

By changing P_x to $\cos x$, we obtain from (B) the celebrated theorem of Fourier. Indeed, that great mathematician appears to have possessed a clear conception of the *principles* of fluctuating functions, although he is not known to have deduced from them consequences so general as the above.

"Again, another celebrated theorem is comprised in the following:—

$$F_y = \varpi^{-1} P_0 \left(\int_{a}^{b} dx \; F_x + \Sigma_{(n)1}^{\infty} \int_{a}^{b} dx \; Q_{x-y, n} \; F_x \right), \qquad \text{(C)}$$

in which, the function Q is defined by the conditions

$$Q_{x,n} \int_{0}^{x} dx \; P_x = \int_{2nx-x}^{2nx+x} dx \; P_x;$$

y is $> a$, $< b$; and no real root of the equation

$$\int_{0}^{x} dx \; P_x = 0,$$

except the root 0, is included between the negative number $a-y$ and the positive number $b-y$, nor are those numbers

themselves supposed to be roots of that equation. When these conditions are not satisfied, the theorem (C) takes other forms, which, with other analogous results, may be deduced from the same principles."

Mr. Petrie exhibited an ancient Irish consecrated bell, recently obtained by the Dean of St. Patrick's, and which had been for many generations in the possession of a family named Hanan, or O'Hanan, in the county of Armagh. This bell is of the usual quadrangular form, in use amongst the Irish from the introduction of Christianity into the country till the close of the eleventh century, but has an approximation to the round form which became general after the latter period. The age of this bell can be determined with perfect accuracy, from the following inscription in the ancient Irish character which is carved upon it.

+ OR̄ aṗ Cumaſcach mc̄ Aililla,

or " Pray for Cumuscach the son of Ailill."

The death of this Cumuscach, who was Economist of the Cathedral of Armagh, is recorded in the Annals of the Four Masters at the year 904. His mother, who was named Gormlaith, was a daughter of Murdach King of Ulster.

The Academy then adjourned to Monday the 9th of November.

DONATIONS.

Archaeologia. Vol. XXVIII. Presented by the Society of Antiquaries of London.

Transactions of the Zoological Society of London. Vol. II., Parts 1, 3, 4, and Proceedings, Nos. 4, 5, 6, 7. Presented by the Society.

Cambridge Astronomical Observations for the Year 1838. By the Rev. James Challis, M.A. Presented by the Author.

Annual Report of the Maitland Club for 1840. Presented by John Smith, Esq.

A Letter to Sir W. R. Hamilton, by Sir Wm. Betham. Presented by the author.

An Essay on the Study of the Celtic Languages, by A. B. Chapin, M.A. Presented by the Author.

Two Gold Fibulæ, found at Castlebar, and purchased by Subscription. Presented by the Subscribers.